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ONSHORE IMPACTS OF OIL AND GAS DEVELOPMENT
IN ALASKA. VOLUME I

Resource Planning Associates

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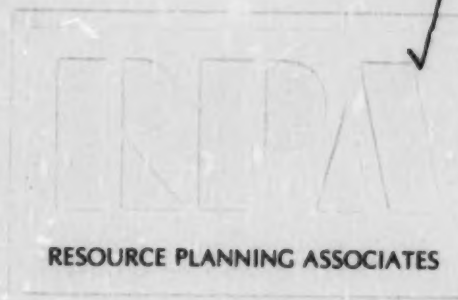
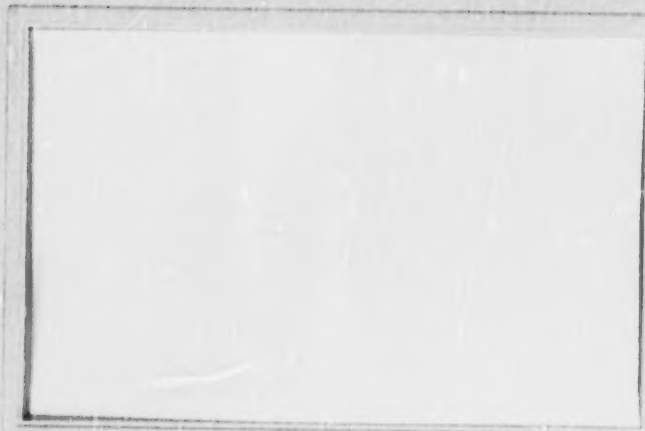
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ONSHORE IMPACTS OF
OIL AND GAS DEVELOPMENT
IN ALASKA

VOLUME I

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ENVIRONMENTAL PROTECTION AGENCY
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ONSHORE IMPACTS OF
OIL AND GAS DEVELOPMENT
IN ALASKA
ENVIRONMENTAL PROTECTION AGENCY

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ONSHORE IMPACTS OF OIL AND GAS DEVELOPMENT IN ALASKA

We have known about the presence of oil and gas in Alaska since late in the 19th century when numerous oil and gas seeps were detected along the coastal boundaries of the Gulf of Alaska Basin. Petroleum was first produced in Alaska in 1902 when the Katalla field was brought into production, and small quantities were produced from that field through 1933, when annual production totaled 4,000 barrels.

The first oil development of significance in Alaska, however, occurred just prior to statehood, with the 1957 discovery of the Swanson River oil and gas field on the Kenai Peninsula. Oil and gas has been produced in commercial quantities from the fields in the Kenai/Cook Inlet area since 1960. By 1974, annual gas production totaled 125 billion cubic feet, while oil production reached approximately 74 million barrels.

Since this first major discovery, several events have combined to accelerate interest in Alaska as an oil and gas province:

- The 1967 discovery of the Prudhoe Bay field. The largest field in North America, Prudhoe Bay is estimated to contain 9.6 billion barrels of recoverable reserves. To transport this supply to markets in the Lower 48, the Trans-Alaska Pipeline System (TAPS) is being constructed, with an initial flow of 1.2 million barrels of oil per day (MMBOPD) anticipated by 1977-1978, peaking at 1.6 MMBOPD by 1980-1981. As current domestic consumption is 17 MMBOPD, this forecasted production from Prudhoe Bay represents a significant addition to domestic supplies. The Prudhoe discovery has sparked interest in the potential for reserves in other private North Slope onshore areas, the Arctic outer continental shelf (OCS) and Naval Petroleum Reserve No. 4 (NPR-4) in particular.
- The Arab oil embargo. The nature of the nation's vulnerability to decisions by foreign oil producers became painfully evident during 1973 when the so-called Arab oil embargo was imposed. In response, the federal government has indicated a desire to stimulate the development of new, domestic oil and gas production. Prime sources for this new production are the frontier areas, including Alaska.
- The quadrupling of crude oil prices in 1973-1974 in conjunction with the Arab oil embargo. These price increases could have a profound effect on the probability of Alaskan

oil and gas development. With prices previously at \$3 per barrel, it was uncertain whether oil and gas produced in Alaska could be delivered at a competitive price. With current crude prices in the \$13 to \$14 per barrel range, the appeal of Alaskan oil and gas is significantly greater.

Several recent analyses have pointed out how important Alaska's oil and gas resources could be to the nation's energy future. The National Petroleum Council's (NPC) energy outlook study, the Federal Energy Administration's (FEA) Oil and Gas Task Force reports for the Project Independence Report (PIR), the Ford Foundation's Energy Policy Project, and the recent FEA updates of the Project Independence projections have indicated that substantial OCS oil and gas development is likely to take place in Alaska during the next 25 years. For example, the 1974 PIR forecasts of production possibilities for Alaska ranged as high as 5.7 MMBOPD and 5.3 trillion cubic feet of gas per day by 1990. The implications of these production possibilities are immense; total Alaska oil and gas production could account for 25-30 percent of U.S. production in the 1990s.

Leasing schedules for potential oil and gas areas by federal, state, and native groups could help make these expectations come true. For example, in November 1974 and in June 1975, as part of the President's energy program to begin exploring and developing OCS resources, the Department of the Interior published its schedule for a 5-year (1975-1979) OCS leasing program. The Alaskan OCS areas for which lease sales have been planned are: (1) the Gulf of Alaska; from east of Yakutat Bay to west of Cape St. Elias (January and December, 1976); (2) Bering Sea, St. George and Norton Basin (1977 and 1978); (3) Bristol Bay (1977); (4) Beaufort Sea (1977); and (5) Chukchi Sea, Hope Basin (1978).^{*} Furthermore, the State of Alaska still plans a lease sale in the Beaufort Sea in 1976.

These areas are located offshore from the varying and, as yet, undeveloped coastal areas of the state. Indeed, only 300 miles (less than 1 percent) of Alaska's 47,300 miles of coastline are considered developed. With the exception of the Cook Inlet/Resurrection Bay areas, most coastal communities range in size from 100 to 1,000 inhabitants, although a few contain populations ranging from 2,000 to 4,000. The economy of the smaller coastal towns tends to be limited to subsistence hunting, fishing, and gathering from both marine and terrestrial systems; these communities are committed to and dependent on the ecosystem.

* As our study was initiated several months prior to the publication of the U.S. Geological Survey's (USGS) June 1975 leasing schedule, the assumptions we made during the initial phases of the study were based on the USGS November 1974 leasing schedule.

In addition, these regions, like most of Alaska, are valuable wilderness and recreational areas. The state's undeveloped areas and geological and zoological features make it unique. In fact, the wilderness, providing unspoiled habitat for a multitude of wildlife, is thought to be so unique that the Native Claims Settlement Act of 1971 stipulated that up to 80 million of the state's 375 million acres be withdrawn and ultimately protected as national parks, forests, wildlife refuges, and wild and scenic rivers.

Against this background of small communities - the State of Alaska as a whole contained fewer than 350,000 people in 1974 - and a highly valued frontier area, the impact of oil and gas development could be as substantial in Alaska as it has been elsewhere. For example, in Scotland, recent North Sea oil and gas development in such previously rural areas as Petershead has created employment opportunities several times the initial labor base. The influx of additional labor to take advantage of the job opportunities has placed a strain on the social and economic structure of the community.

In addition, efforts are already being undertaken to determine the impacts of TAPS construction. Specifically, in Fairbanks, a major staging ground for construction of the northern section of TAPS, the impact of new construction workers and unemployed boomers is altering the lifestyle of Fairbanks' original inhabitants, although not to the extent originally anticipated. But Fairbanks has been able to absorb its new inhabitants comparatively better than the other major staging area, the significantly smaller community of Valdez (1973 population of 1,106). Because of its size, Valdez did not have an adequate infrastructure to support the influx of new inhabitants involved in terminal and pipeline construction (July 1975 population of 6,670).

The combination of large scale development, small communities with undeveloped infrastructures, and a fragile ecosystem could combine to produce secondary environmental consequences as important as primary effects. Consequently, the U.S. Environmental Protection Agency (EPA), which has the responsibility, authority, and means for influencing potential environmental impacts in Alaska as well as the rest of the country, wanted to identify and address the potential environmental problems in Alaska resulting from oil and gas development. To this end, the EPA wanted answers to three rather specific questions:

- What is the likely level of oil and gas development in Alaska? USGS estimates total Alaskan oil reserves at 43 billion barrels (30 percent of the U.S. total) and natural gas reserves at 123 trillion cubic feet (13 percent of the U.S. total). But since the economics of development, as well as other factors, are constantly changing, periodic reassessment should be conducted of the overall probability of full-scale development, the likely priority of development of the various regions with oil and gas potential within the state, and the length of time required to realize substantial production.

- What are the potential environmental impacts associated with this development? Effects from both primary and associated-secondary development could be large. To date, most studies have concentrated on evaluating primary impacts on a project-by-project basis, but environmental effects (e.g., air emissions, land requirements) of secondary activity, especially related to increased economic activity and incremental population growth, also need to be assessed.
- What are the implications of the potential secondary environmental impacts? Development is likely to lead to increased employment opportunities and subsequent population growth, which, in turn, could change the face of various communities, require new infrastructures, and impact the quality of life and the environment in a negative way. The extent to which this could occur needs to be determined.

Resource Planning Associates, Inc. (RPA) was retained to answer these three questions and to recommend to the FPA what the agency can and should do now to mitigate the projected environmental impacts associated with oil and gas development in Alaska. To this end, in a one man-year effort, RPA carried out five major tasks:

1. Define geographic development possibilities. This task involved: (a) identifying likely development areas (see Exhibit 1); (b) estimating the timing and level of effort for exploration, discovery, delineation, development, and production; (c) estimating the likely facilities needed to process and transport the oil and gas (e.g., pipelines, crude and gas terminals, gas processing and liquefaction plants); and (d) combining these development assumptions into 12 scenarios (Exhibit 2).*
2. Select communities for impact analysis. Based on the location of potential oil and gas reserves, ten communities were selected as those with the greatest potential for being affected by oil and gas development - Anchorage, Barrow, Bethel, Cordova, Fairbanks, Kotzebue, Nome, Seward, Valdez, and Yakutat. (See Exhibit 3.) Initially, we developed a current community profile as general background information, including population and employment statistics, development

* The development scenarios were cumulative; that is, each included all development alternatives from the previous scenario in addition to the next-ranked alternative. The individual alternatives are summarized in Appendix 1; the methodology used to develop them is described in detail in Appendix A of Volume II.

potential (based on land availability), and environmental quality (air and water quality, ecosystem characteristics).^{*} But because data were not consistently available on the community level or the election district^{**} level, both levels (i.e., community and election district) were used in our analysis. For example, data on air quality were collected and potential air emissions were estimated at the election district level, whereas land requirements could be projected only at the community level.

3. Project changes in employment and population. To translate oil and gas development and related facilities assumptions into forecasts of primary and secondary economic impacts (e.g., employment and population changes) for each scenario, we developed a methodology that involved the use of an econometric model.^{***} Primary employment estimates were used as inputs to the model to develop estimates of annual secondary employment, population, and unemployment at the state level.^{****} (See Exhibit 4.) The model was then run for each development scenario, and the state results were disaggregated to the election district level, focusing on those election districts most likely to be affected by oil and gas development.
4. Translate socioeconomic changes into environmental impact projections. Forecasted population and employment changes for each scenario were translated into potential air emissions and land requirements, using the methodology detailed in Appendix C of Volume II. Potential emissions of particulates, sulfur oxides, nitrogen oxides, hydrocarbons, and carbon monoxide from major source classifications (e.g., residential, commercial-institutional, solid waste generation) were estimated. Acreage requirements for new residential,

* Appendix 2 contains the area descriptions as well as our final impact projections for purposes of comparison.

** Comparable to the county level in the Lower 48.

*** Appendix B of Volume II describes the methodology and explains the model in detail.

**** The model was used as developed. But since the model was built to estimate the short-run impacts of Alaska pipeline employment, it tends to preserve the structure of the Alaskan economy as it is today - i.e., a highly services-oriented economy. The change in the economy's structure as it grew larger is not reflected in the model. Thus we feel the model tends to overestimate impacts somewhat.

commercial, and other purposes were also estimated, based on incremental employment and population resulting from each development scenario. However, the limited data available prevented a similar quantification of impacts on water quality. Instead, we assessed expected changes qualitatively.

5. Recommend appropriate actions to EPA. To determine what the overall focus of EPA's activities should be in Alaska, we analyzed and integrated EPA's charter, their current activities in the state, and the types of onshore impacts likely to result from oil and gas development.

The results of these tasks are presented in the remainder of this report in terms of: (1) study findings and conclusions; and (2) study recommendations for EPA action.

STUDY FINDINGS AND CONCLUSIONS

Overall, we have concluded from our analysis that the potential secondary impacts, both economic and environmental, on Alaska resulting from OCS as well on onshore oil and gas development will be substantial.* These impacts will be felt on a local basis in varying degrees of severity (Exhibit 5). The quantification of these local area results is contained (in great detail) in Appendix 2. Some localities, such as Anchorage and Fairbanks, will receive impacts from nearly every development possibility, while others, such as Nome, Valdez, and Yakutat, will experience impacts from only a few scenarios.

The economic impacts would of course be felt through growth in:

- Population. At the state level, under base case conditions (i.e., the absence of any further oil and gas development subsequent to completion of TAPS), population could reach 488,000 by 1980 and 800,000 by 1990, a 5.5-percent implied growth rate for 1975-1990. At the other extreme, under maximum development (i.e., realization of the scenario that assumes execution of all oil- and gas-related projects, including the development of reserves in the Arctic Wildlife

* The largest impacts generally come from those scenarios involving large construction projects, including North Slope Natural Gas (a trans-Alaska pipeline), Gulf of Alaska (three large liquified natural gas plants, natural gas processing), Beaufort Sea (two additional trans-Alaska pipelines), NPR-4 (trans-Alaska pipeline and large connector), and Chukchi Sea (large pipeline). In general, however, all development scenarios will impact at least one locality substantially, while many will impact two or more localities to some important extent. (See Exhibit 5.)

Range), the state population would exceed 800,000 by 1980 and climb to 1.2 million in 1990, an 8.5-percent implied growth rate for 1975-1990. (See Exhibit 6.)

On a more localized level, in virtually all scenarios, Anchorage will witness growth in its population - up to 2½ times its current level by 1990 under maximum-development conditions. In addition, in small towns in which growth has been minimal in the recent past, a sudden expansion of population could be detrimental to the lifestyles of the inhabitants. If the Gulf of Alaska scenario were realized, for example, the population of Yakutat-Skagway would almost double by 1980 and nearly triple by 1990 (Exhibit 7). Unless careful planning were undertaken to displace the impacts or provide for them, it is doubtful that the capacity of necessary community services (e.g., education, health care, personal protection) could be increased to a level corresponding to the needs of the population.

- Employment. Opportunities for employment in primary activities and particularly in service-oriented jobs will occur in communities close to the oil and gas reserves, as well as in the major population centers of Anchorage and Fairbanks. However, many of these jobs will require skills not offered by the Alaskan population (Indians, Eskimos, Aleuts, or whites), and outsiders migrating to the state to fill these skilled positions could replace currently employed residents in less-skilled jobs. For example, if the NPR-4 scenario were realized, employment in Barrow, the community with the greatest number of native Alaskans, could double by 1978, almost triple by 1980, and reach 5 times the base-case level for 1990. But the sheer availability of jobs could attract large numbers of unskilled people to the area, and the resulting unemployment could be substantial.

The implications of such socioeconomic growth are better understood when projected population and employment changes are translated into incremental environmental impacts on:

- Air. Overall, if new employees and their dependents move to Alaska to participate in oil and gas development, they will require corresponding numbers of new residences, commercial buildings, and vehicles. Thus, the level of air emissions generated during the daily operation of these facilities will most certainly increase. If, for example, development were to occur in Kotzebue Sound, Nome would experience nearly 2½ times the level of emissions if no development occurred by 1980, and nearly 3 times the base case pollutant levels by 1990.

Although data on current ambient air quality were usually not available for many of the locations studied, some areas clearly will not be able to meet primary air quality standards. Fairbanks, for example, where concentrations of particulates and carbon monoxide exceed state standards at some locations, could be subject to increased emissions of 20-50 percent.

- Land. Requirements for new facilities to support the new Alaskan population and for new industries related to oil and gas development could also be significant enough to put extreme pressure on local communities. Acreage requirements for development in Anchorage, for example, could exceed the total amount of land now vacant in the Greater Anchorage Area Borough (108,000 acres). Total use of this area could have adverse impact on surrounding forested areas and lowlands.
- Water. In all localities in which growth occurs, water quality could be affected by an increased municipal sewage load; in some localities, it could be further affected by industrial effluents. In Fairbanks, for example, the capacity of the new treatment plant will have to be evaluated periodically and critically as oil and gas development activities proceed.

STUDY RECOMMENDATIONS FOR EPA ACTION

To develop appropriate recommendations for EPA action, we had to consider not only the projected economic and environmental impacts with which the agency would have to cope, but also the kinds of responsibilities it already had and the way in which they were being carried out.

The agency's primary mission in relation to Alaskan oil and gas development is to balance the needs of developing increased energy supplies with those of protecting the environment. Principal functions in carrying out this mission at the federal and the regional level include:

- Preparing environmental impact statements on EPA activities and reviewing the environmental impact statements of other agencies
- Providing financial and technical assistance to state and local governments to achieve environmental objectives (e.g., pollution control)
- Evaluating and controlling a broad range of environmental health problems, including water quality and solid waste management; researching and developing relevant criteria and standards; and administering planning and demonstration grants

- Conducting studies of and research on ecological systems
- Researching effects, promulgating criteria as the basis for setting standards, and providing financial and technical assistance to agencies to comply with the Clean Air Act
- Setting standards ensuring compliance with National Pollutant Discharge Elimination System permits, enforcing standards (e.g., Safe Water Drinking Act), and providing construction grants and technical assistance for water-related environmental problems.

Within the scope of its mandate to influence the degree to which Alaska as a whole is affected by oil and gas development and within the scope of its present responsibilities, we have identified five types of actions that EPA, especially the Office of Planning and Evaluation (OPE), can take:

1. Influence the actions of other federal agencies through the National Environmental Protection Act (NEPA) compliance procedures (Office of Planning and Evaluation)
2. Influence the actions of the State of Alaska through NEPA and joint study efforts and grants (all offices of EPA)
3. Identify long-range environmental problems and possible solutions through a comprehensive research and development program (Office of Energy Research)
4. Monitor and manage air and water quality (Alaska Operations Office, Region X)
5. Provide community environmental services (Arctic Environmental Research Laboratory).

Influencing Other Federal Agency Actions

The primary means by which the OPE can influence potential secondary impacts of oil and gas development on the Alaskan environment is through NEPA compliance procedures. EPA has the responsibility, in reviewing other federal agencies' environmental impact statements, to see that all important secondary as well as primary impacts are addressed. We recommend that OPE use the results of our study as a framework for re-

viewing whether other federal agencies have adequately addressed, both quantitatively and qualitatively, the potential secondary impacts in their Environmental Impact Statements. In addition, the results of the study may be useful to the Administration in determining the level of impact aid needed in Alaska to finance infrastructure facilities and services associated with oil and gas development.

To put this recommendation into practice over the next year, EPA - and OPE in particular - will have major responsibilities for reviewing the Environmental Impact Statements and suggesting alternative actions and mitigating measures related to several major oil and gas development projects in Alaska:

- Northern Gulf of Alaska lease sale. In March 1975, the Bureau of Land Management (BLM) distributed its December 1975 lease sale list of 330 specific tracts, totaling 1.8 million acres in the Northern Gulf of Alaska. The tracts extend seaward from the 3-mile territorial water boundary to the 200-meter contour line, and from just north of Middleton Island east to Icy Bay. The draft Environmental Impact Statement for this sale was made available on June 27, public hearings were held in Anchorage on August 12-13, and written comments by EPA and others were due shortly thereafter. However, a majority of Alaskan state and local officials have asked for delays until significant OCS-related legislation currently before Congress is voted on, and until additional environmental studies related to Gulf of Alaska development are completed.* The lease has been delayed several months, and is currently scheduled for January 1976.**
- Natural gas pipeline route decisions. Two competing applications have been submitted, one to the Federal Power Commission (FPC) and the other to the Department of the Interior (DOI), proposing to transport North Slope natural gas to markets in the Lower 48.

* BLM is currently conducting several research projects: studies of environmental base line conditions (through National Oceanic and Atmospheric Administration); and studies of the socioeconomic impacts on three Alaskan communities, using Kenai Peninsula development as an analog. These studies will be completed over the next 12 months, with the exception of the National Oceanic and Atmospheric Administration studies, which are expected to be a 4-year effort.

** Our preliminary analysis of the BLM EIS is being submitted under separate cover.

One proposal, submitted by the Arctic Gas Project, a consortium of 18 U.S. and Canadian gas companies organized into the Alaskan Arctic Gas Pipeline Company and Canadian Arctic Gas Pipeline Company, proposes construction of a 6,000-mile pipeline, running southeast from Prudhoe Bay across Canada's Mackenzie Delta to a point near Calgary, Alberta. From there, the pipeline would branch in three directions. One leg would extend eastward to midwest and eastern U.S. markets, ending near Pittsburgh, Pennsylvania. The other two branches would run westward to points near Los Angeles and San Francisco, for West Coast markets. This 3-pronged pipeline would deliver 4.5 billion cubic of gas per day (2.25 BCFGPD from Alaskan fields) at peak capacity, and would cost an estimated \$9.5 billion.

A second proposal, filed by El Paso Alaska, a subsidiary of the El Paso Natural Gas Company, suggests the construction of an 809-mile pipeline, running south from Prudhoe Bay to the southern coast of Alaska at Gravina Point, paralleling the Trans-Alaska oil pipeline. From there, the gas would be liquefied and shipped by tanker to southern California, where it would be regasified and pumped into existing distribution lines. El Paso estimated the cost of its project, including the tankers, at \$6.7 billion. At peak capacity, the system would move an estimated 3.5 billion cubic feet of gas per day.

Subsequent to the filing of these proposals, the Arctic Project applied for DOI right-of-way permits, and on July 28, 1975, the DOI released a draft EIS for Arctic's proposed route. Although the EIS indicated that some significant environmental problems exist, it projected that most of these problems could probably be overcome. El Paso has not applied to DOI for right-of-way permits, contending it is waiting for the FPC decision on its application. The FPC's draft statement is expected to be available before the end of the year.

There is an immediate need for EPA to respond to DOI's EIS, and a longer term need to respond to the FPC's (or other federal agency's) EIS on the suggested route. Significant impacts apply to Lower 48 areas as well as to Alaska, and there is substantial controversy over the relative impacts on both areas of each project. Secondary impacts, including those related to end-use distribution as well as those related to construction and operations, are particularly important in this project.

The actions that the State of Alaska takes in relation to taxation of reserves and the use of its royalty gas are also relevant in estimating impacts.

- NPR-4 exploration. Recent legislation passed by Congress has called for an accelerated exploration program for NPR-4, encompassing 24 million acres in northwestern Alaska. House legislation called for the Department of the Interior to assume responsibility for petroleum reserve exploration, development, and production, while the Senate bill retained control for the Navy. Regardless of which agency is given control in House/Senate conference, it is clear that exploration activities in NPR-4 will accelerate.

The Navy issued a draft EIS for exploration in Zone "A" (northeast section) in February 1975, and has awarded a contract for exploration activities to a consortium headed by the Husky Oil Company. The Navy has also issued a Request for Proposal for contractor assistance in preparing a draft EIS for exploration of the entire reserve. The original timetable indicated that a draft EIS would be ready for EPA review in Summer 1976. Because of the significant resource and environmental impact potential of NPR-4 exploration, development, production, and, particularly, transportation to the Lower 48, we believe it is important that OPE monitor closely developments in this project.

- Other oil and gas development. Additional Environmental Impact Statements will be developed for other federal actions associated with such projects as: (1) the OCS lease sales in the Western Gulf of Alaska,* Lower Cook Inlet, Bering Sea, and Chukchi Sea; (2) the development, production, and transportation phases of NPR-4 development; and (3) additional transportation and processing requirements of all Alaskan oil and gas projects. Our study provides a framework for evaluating the aggregate impacts of these and all other projects. Thus, our study facilitates EPA analysis of the cumulative impacts of these projects on areas such as Anchorage and Fairbanks that are more affected by all projects than by any specific project.

Influencing the State of Alaska

In addition to influencing other federal agencies through NEPA compliance procedures, EPA is in a strong position to influence the State of Alaska's actions in two ways. First, for state leasing

* This lease sale is currently scheduled for December 1976.

actions, such as leasing acreage in the Beaufort Sea and other OCS areas within the 3-mile limit and leasing land in onshore areas, EPA is the primary federal agency since it must approve discharge permits. Consequently, EPA may require that state and private companies provide evidence that they have adequately considered the secondary, as well as primary, impacts of oil and gas development.

Second, EPA is in a position to coordinate effectively with other federal agencies and with key Alaskan agencies in supporting Alaskan environmental research. Specifically, it can seek to improve documentation (e.g., develop bibliographies, source lists, and indices) of specific investigations, studies and reports in the major disciplines (e.g., environmental sciences, sociology, economics, history, archeology, mental sciences). Just as many coastal states concerned with OCS development are seeking federal aid, so, too, is Alaska, particularly in the form of revenue for environmental research and onshore services. Such revenues are obtainable from both DOI (BLM) under existing legislation, and through Congress by way of new legislation. The State of Alaska has joined in this effort, and its agencies are seeking grants and joint study efforts with EPA and other federal agencies to identify socioeconomic and environmental impacts and measures to mitigate such efforts. In addition to cooperation, the EPA could play an essential role by providing an effective coordination mechanism for all research being conducted.

Identify Long-Range Environmental Problems

A third action that EPA (OER) could take is evaluating the energy-related environmental research and development (R&D) needs in the State of Alaska. Although the EPA has already conducted some R&D efforts in Alaska, more study is needed by the OER, which has the authority to perform studies and research related to ecological systems. Such research has been conducted in Alaska by both the EPA research laboratories and the OER. In addition, significant socioeconomic and environmental research has been conducted by other federal agencies, Alaskan state agencies, local governments, and private industry. A summary of this research by type of study is provided in Exhibit 8. Research programs conducted by the EPA and other federal, state and local agencies, and by private companies in Alaska, are categorized in Appendix 3 as they relate to air pollution, water pollution, ecosystems, wildlife, primary oil and gas exploration and production impacts, pipeline impacts, and socioeconomic conditions and impacts. (Considerable data on secondary impacts of oil and gas production have been developed in these research programs.)

Managing Air and Water Quality

The fourth action we recommend for EPA involves the traditional EPA regional and local responsibilities of monitoring and managing

air and water quality. Some of these activities are now being carried out in Alaska by EPA's Region X Alaska Operations Office, including:

- Enforcement of state air quality standards
- Periodic monitoring to provide input to National Aerometric Data Bank (limited coverage in Alaska) and National Emissions Data Systems. Since Alaska will be the focus of domestic oil and gas development activity in the very near future, detailed base line studies involving environmental, (especially ambient air and water quality, current air emissions, and water effluent rates), social, and economic data for all of the regions in the state will be mandatory to lease, explore, develop, and transport the state's hydrocarbon resources.
- Involvement in construction grant program for wastewater treatment plants and interceptor sewers (coordination through Seattle Region X Headquarters)
 - Planning stage: Sitka and Ketchikan
 - Design stage: Skagway and Wrangell
 - Construction stage: Cordova, Haines, Kodiak, Juneau (2), Petersburg
 - Operating stage: Fairbanks, Valdez.
- Monitoring of facility compliance with National Pollutant Discharge Elimination System permit program.
- Monitoring of water quality to update data bank (in conjunction with USGS).
- Aid in implementation of safe water drinking program in six villages.
- Performance of ongoing air and water quality R&D.

Since the bulk of EPA's Region X Alaska Operations Office activities are not directed toward oil and gas production, we did not direct our study efforts at analyzing its program in depth. However, in the feasibility studies for wastewater treatment plants and interceptor sewers, there is a need for EPA to consider the proposed location and to forecast population levels in relationship to population sizes and locations as projected in our study and further documented by oil and gas industry plans.

Providing Community Environmental Services

The fifth action we recommend for EPA involves the agency's responsibility and authority to evaluate and control a broad range of environmental health problems, including water quality, solid wastes, and miscellaneous health services (where not otherwise provided). Because the EPA's Arctic Environmental Research Laboratory in Fairbanks is responsible for conducting some of these activities in Alaska, we recommend that the EPA carefully define the role of this laboratory, particularly as its activities concern:

- Alaska Village Demonstration Project. EPA finances, builds, and initially operates central village facilities consisting of waste treatment facilities for "honey-bucket" sewage systems; fresh water supplies delivered to houses by vehicle or picked up by villagers; and a laundromat, showers, and saunas.
- 1973 Alaska Solid Waste Management Regulations, which EPA helped develop.
- Ongoing R&D.

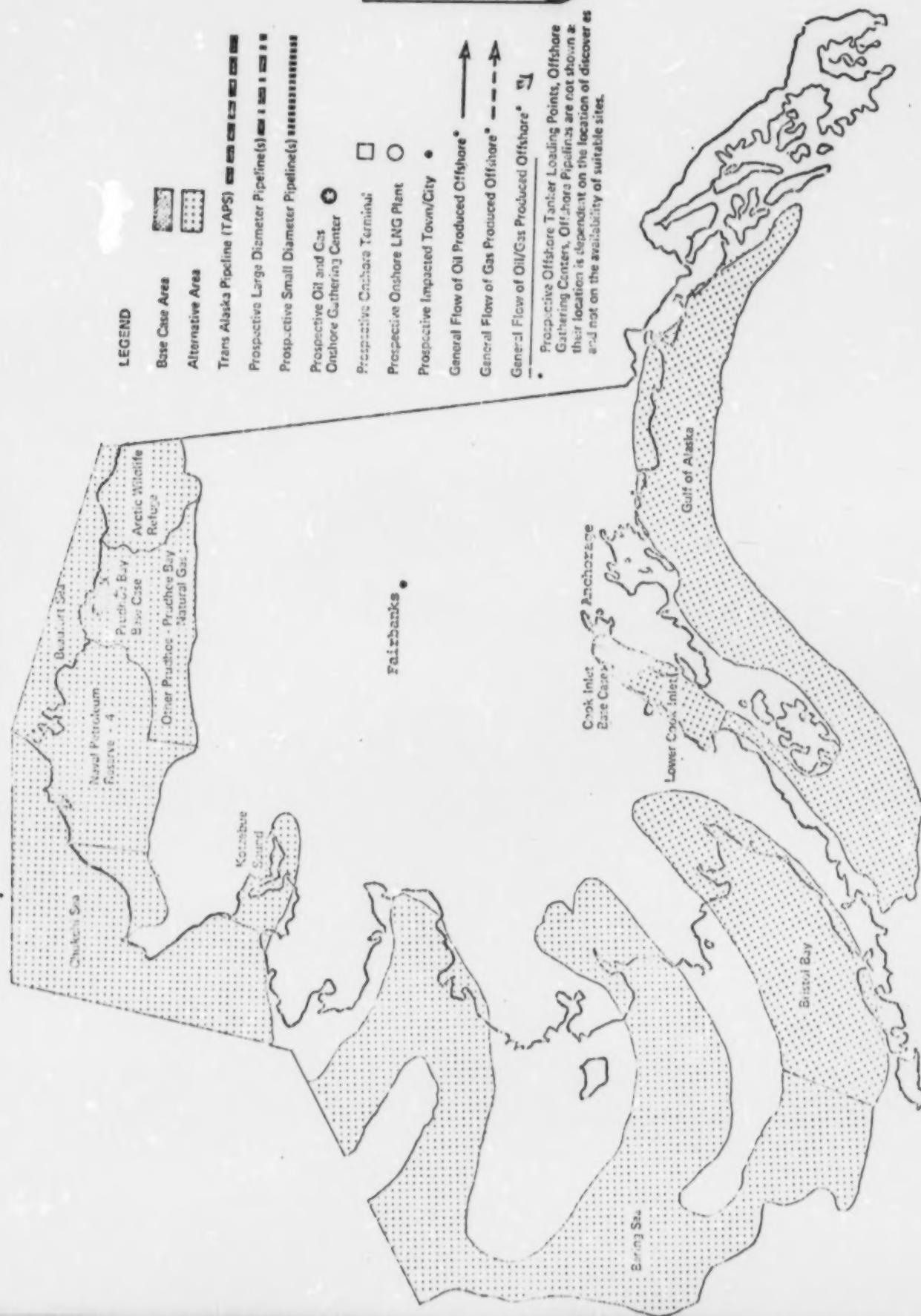
* * *

In summary, EPA, through its Office of Planning and Evaluation, Office of Energy Research, Region X Alaska Operations Office, and Arctic Environmental Research Laboratory, has major responsibilities in mitigating primary and secondary environmental impacts for all aspects of the development process - from the planning stage, through the NEPA compliance mechanism, to the actual operations stage of oil- and gas-related activities in Alaska. And although it was not within the scope of this study to develop a complete strategy for EPA activities in Alaska, we have identified some of the responsibilities of and proposed possible actions for EPA because we believe that the agency will play an increasingly greater role in Alaska in future years. Oil and gas development will significantly affect both the ecosystems and, more importantly, the quality of life for Alaskans. Indeed, their primary concerns will be these so-called "secondary" impacts of oil and gas development. As such, many Alaskans are even now more concerned with achieving basic amenities - such as adequate housing, education, health care, and clean water - than they are with preserving the pristine, rural appearance of the Alaskan environment. It is those concerns, then, that must be met, and it is becoming EPA's increasing responsibility to meet them.

THE TWELVE DEVELOPMENT ALTERNATIVES

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Exhibit 1



RANKING OF DEVELOPMENT ALTERNATIVES

1. Upper Cook Inlet and Prudhoe Bay oil
2. Other private development at Prudhoe Bay
3. Prudhoe Bay natural gas development
4. Gulf of Alaska
5. Beaufort Sea
6. Bering Sea
7. Lower Cook Inlet
8. Kotzebue Sound
9. Bristol Bay
10. NPR-4
11. Chukchi Sea
12. Arctic Wildlife Range

THE TEN IMPACT COMMUNITIES



AREAS OF POTENTIAL OIL
AND GAS DEVELOPMENT

CATEGORIES OF FORECASTS

Population

Employment

 Primary

 Mining

 Construction

 Manufacturing

 Wholesale trade

 Transportation

 Secondary

 Utilities and communications

 Federal government

 State and local government

 Retail trade

 Finance, insurance and real estate

 Services

 Noncategorized

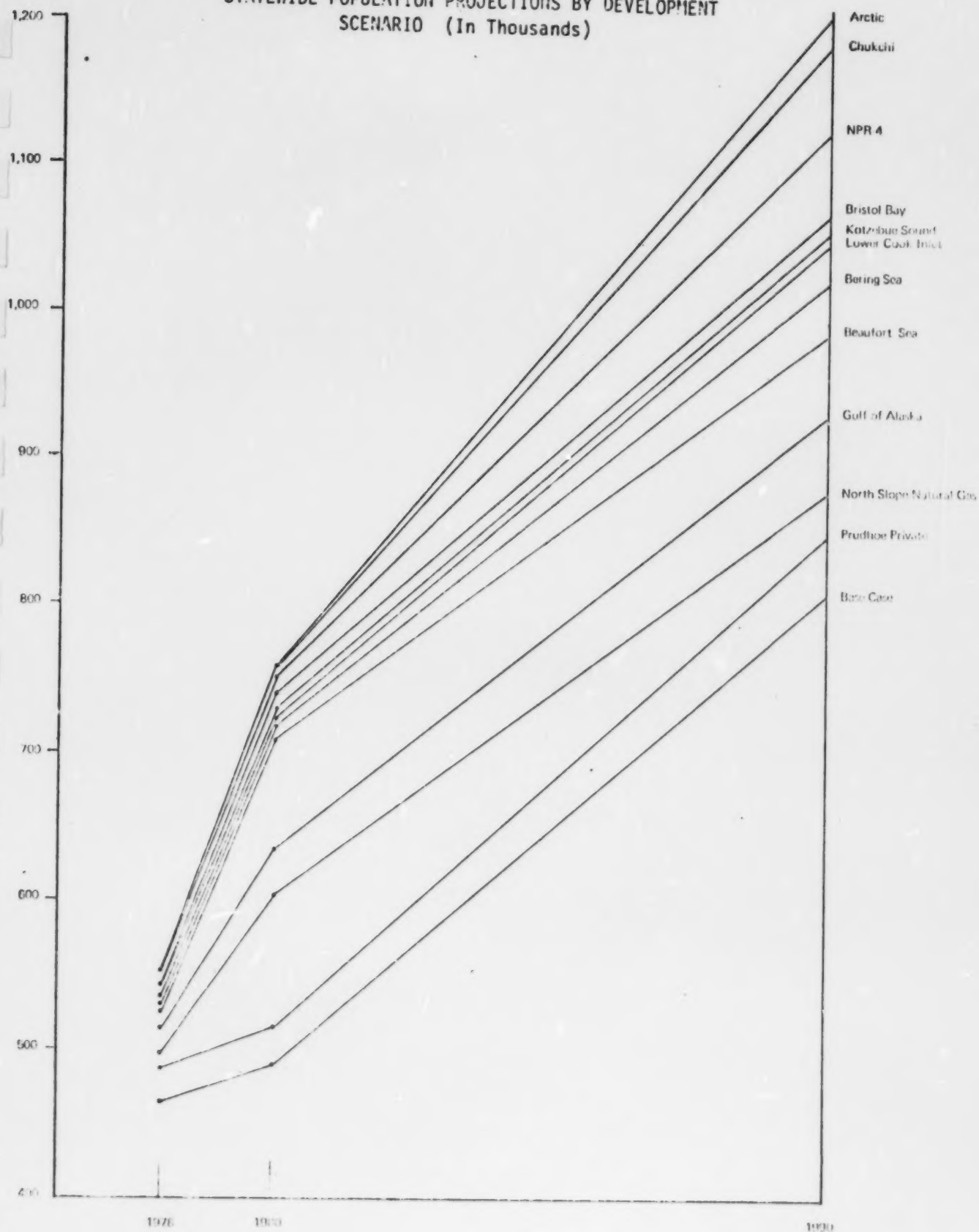
Unemployment

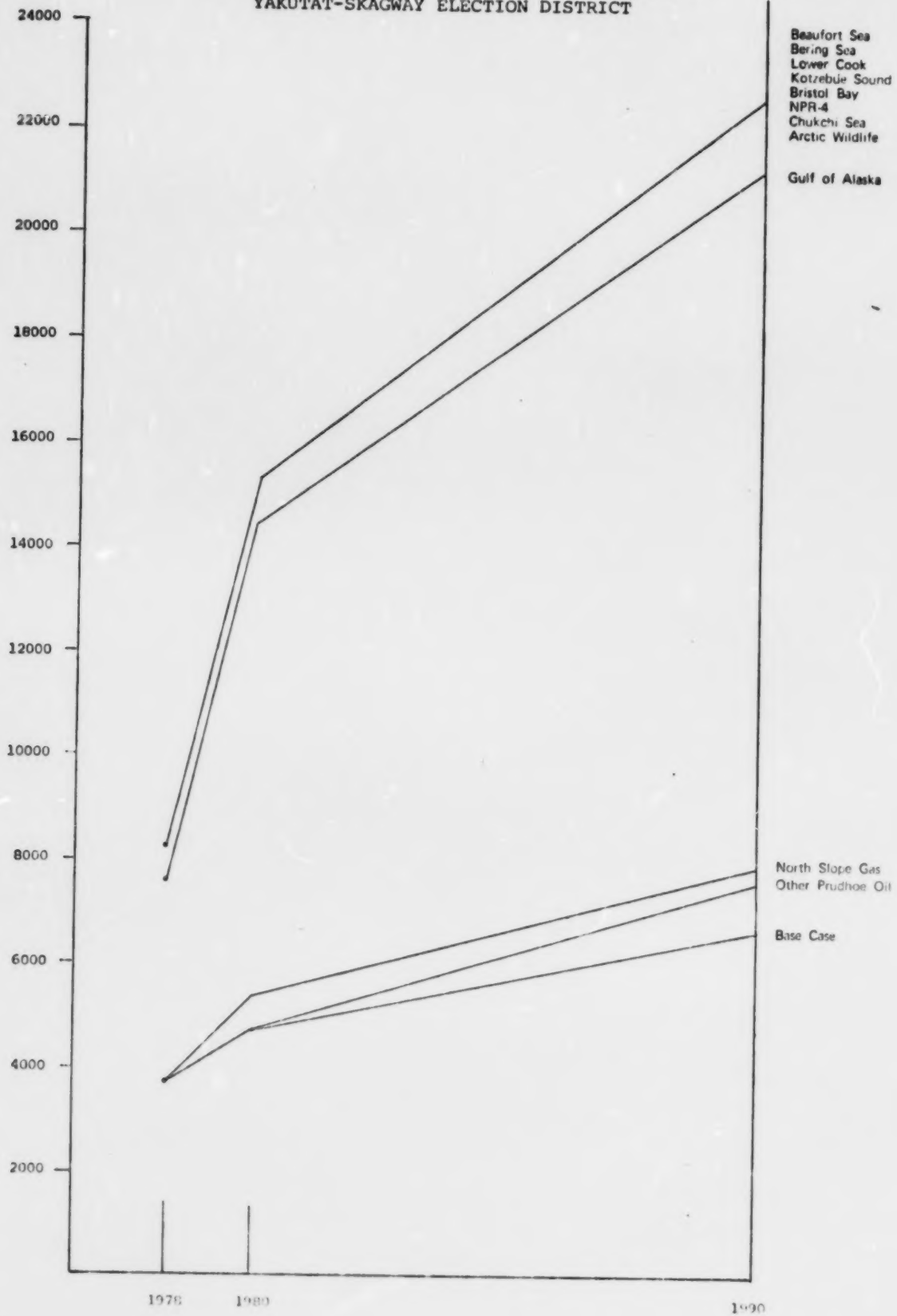
POPULATION IMPACTS ON GEOGRAPHIC AREAS

SCENARIO:	IMPACT AREAS:									
	Anchorage	Barrow	Bethel	Cordova	Fairbanks	Kotzebue	Nome	Seward	Valdez	Yakutat
Other Prudhoe Private	L	L	L	L	H	L	L	L	L	L
Prudhoe Bay Gas	L	L	L	H	H	L	L	L	L-H	L
Gulf of Alaska	L	L	L	H	L	L	L	H	L	H
Beaufort Sea	L	L	L	H	H	L	L	L	L-H	L
Bering Sea	L	L	H	L	L	L	H	L	L	L
Lower Cook Inlet	L	L	L	L	L	L	L	H	L	L
Kotzebue	L	L	L	L	L	H	L	L	L	L
Bristol Bay	L	L	L	L	L	L	L	L	L	L
NPR-4	L	H	L	H	H	L	L	L	L-H	L
Chukchi Sea	L	H	L	L	L	L	L	L	L	L
Arctic Wildlife	L	H	L	L	L	L	L	L	L	L

H = High Impact

L = Low or No Impact

STATEWIDE POPULATION PROJECTIONS BY DEVELOPMENT
SCENARIO (In Thousands)

POPULATION PROJECTIONS BY DEVELOPMENT SCENARIO -
YAKUTAT-SKAGWAY ELECTION DISTRICT

SUMMARY OF RESEARCH ACTIVITIES IN ALASKA

Organizations	Research Areas	Effects of Oil-Related Activities on the Environment		Effects on Other Measures on Ecosystems	Water Management & Water Quality	Sewage Treatment Experiments	Air Quality/ Pollution Studies	Pipeline Impact	Socio-economic Studies	
		Aquatic	Terrestrial							
<u>Private</u>										
Amer. Smelting & Refining										
Collier Carbon & Chemical										
Esso Prod. Co.							•			
Petroleum Res. Founda.										
Canadian Arctic Gas								•		
Alyeska		•	•					•		
Cities Serv. Oil Co.		•							•	
National Bank of Alaska										
<u>State</u>										
Dept. Natural Resources							•			
Alaska Coop Wildl. Res. Unit										
OWRR					•	•				
ADFG										
Tundra Biome Center										
U. of A. Sea Grant Program									•	
Alas. St. Housing Author.								•	•	
Governor's Office-Planning & Res.								•	•	
Fed.-St. Land Use Planning Com.										
Dept. of Environmental Conserva.		•		•	•		•			
<u>Federal</u>										
BLM		•	•	•	•				•	
USGS					•			•		
USF&W Serv.		•						•		
USB of SP&W										
EPA		•	•	•		•	•			
ONR		•								
HEW										
USFS										
NOAA										
KNPS										
Coast Guard		•								
NSF										
CRRL, U.S. Army			•	•	•	•	•	•		
NARL			•			•				
IBP			•	•						
AEC										
Nat'l Park Service										
Bureau of Mines		•								
Canada		•						•		
Dept. of Labor-Manpower Admin.									•	
FPC									•	
<u>Local</u>										
Anchorage Borough								•	•	
Fairbanks Borough							•		•	
Kenai Peninsula Borough					•				•	

STATEWIDE DEVELOPMENT SCENARIO RESULTS

In total, Alaskan population could reach 1.2 million and employment could rise to 68,000 by 1990. However, these statewide economic impacts varied, of course, as the assumption used in the several development scenarios varied. To facilitate understanding the range of results possible and the reasons they could occur, each development scenario is discussed in terms of its assumptions* and its economic results (i.e., employment and population growth).**

PRUDHOE BAY AND COOK INLET BASE CASE

Current production in Cook Inlet, and the construction and operation of facilities related to Prudhoe Bay development (including the pipeline and terminal) have been selected for the base case. No further exploration or discoveries are assumed in these areas. In the scenario, Cook Inlet oil production is expected to decline gradually from the current 200,000 BOPD to 90,000 BOPD in 1990, while gas production in that area is expected to increase to around 800 MMCGPD in the same time period. We further assumed the Alyeska pipeline will be completed on time, with output reaching 1.6 MBOPD at its peak. Gas is assumed to be reinjected. (See Exhibits 1-1 and 1-2.)

Under these assumptions, total population will rise to 488,000 by 1980 and 813,000 by 1990. Population growth per annum would average over 5 percent in the 1980-1990 period. Employment is expected to grow to 177,000 in 1978; 190,000 in 1980, and 334,000 in 1990. (See Exhibit 1-3.)

OTHER PRUDHOE PRIVATE

In this scenario, it was assumed that exploration will continue at Prudhoe Bay, with oil discoveries occurring in 1979 and 1981, and gas discoveries occurring in 1979 and 1980; in addition, there will be further development to increase pipeline input. Production from further development is expected to increase from around 385,000 BOPD in 1980 to a peak of 926,000 BOPD in 1988. We assumed no gas will be produced because pipeline facilities will be unavailable. (See Exhibit 1-4.)

* A much more detailed treatment is given in Appendix A, in a separate volume.

** Each scenario includes the development alternative being described as well as all alternatives immediately preceding it. Thus, the impacts are cumulative as the discussion proceeds.

Additional facilities will be needed, including looping the Alyeska line and almost doubling the Valdez terminal capacity by 1980, with most of the construction taking place in 1979 and 1980.

With these assumptions, population is expected to increase to 489,000 by 1978, 519,000 by 1980, and 858,000 by 1990. This implies growth rates of over 11 percent, less than 5 percent, and over 5 percent for the periods 1975-1978, 1978-1980, and 1980-1990, respectively. Total employment is expected to grow somewhat faster, rising to over 200,000 jobs in 1980, and over 350,000 in 1990. Unemployment could actually drop between 1978 and 1980 as construction activity and mining increase; it could average almost 12 percent of the labor force in 1980 and 1990, compared with 13.5 percent in 1978.

PRUDHOE BAY NATURAL GAS - EL PASO

The scenario assumed the El Paso Trans-Alaska Pipeline proposal will be approved by the Federal Power Commission, and the pipeline and related liquefaction and terminal facilities will be built. Further, gas wells will be developed, beginning in 1980 and lasting through 1985. Area gas will also be produced from the other Prudhoe private development alternative.

Construction of the pipeline, liquefaction, and terminal facilities, beginning about 1977, could employ up to 14,500 by the peak year, 1981. As the maximum planned capacity of the pipeline is 3,300 MMCFGPD, under our assumptions (which include the further exploration development of Prudhoe Bay), additional compression stations on the El Paso pipeline could be required by 1986 to accommodate additional volumes of gas. Liquefaction and terminal facilities, assumed to be located near Gravina Point, would also be expanded to accommodate this volume. (See Exhibit 1-6.)

With this scenario, population is expected to grow to almost 500,000 by 1978, a growth of almost 43 percent from current levels. Population would continue to expand to over 600,000 by 1980, with growth averaging a 7.5 percent rate in the 1980-1990 period.

PRUDHOE BAY NATURAL GAS - ARCTIC

This scenario considered development prior to and including the Trans-Canadian pipeline project and related gas development on the North Slope. Gas wells were assumed to be in production by 1980. Gas will also be produced as a result of the other Prudhoe private development alternative.

Pipeline construction will be initiated in 1977 and completed during 1980-1981. Production will peak at 2,250 MMCFGPD in the first few years of operation; however, the pipeline system could be expanded with the installation of compressor stations in Alaska to

accommodate as much as 4,500 MMCFGPD. (See Exhibit 1-8.) During the peak year of construction, direct employment in Alaska is anticipated to be approximately 850.

If this scenario should occur, the state population would increase in 1978 by only 1,000 persons over the expected population resulting from the previous scenario. However, by 1980 the population could reach 524,000 and could total 874,000 by 1990, a total increase of 67 percent from 1980 to 1990. (See Exhibit 1-9.)

GULF OF ALASKA

In this scenario we assumed exploration will take place in the Gulf of Alaska from 1975 through 1991, with peak exploratory activity occurring in the years 1979 to 1982 when 36 wells per year will be drilled. Five oil discoveries and six gas discoveries were assumed, with at least one discovery occurring in each of the years 1977 to 1986. Development drilling was assumed to lag behind discoveries by 3 years. We further assumed that offshore tanker loading will be used for shipment of Gulf of Alaska crude, beginning in 1982 and rising to a peak of almost 550,000 BOPD sometime after 1990. Gas production was assumed to lag oil production by 1 year, beginning in 1983 and peaking at over 2 billion CFGPD in 1990. To accommodate this gas production, three gas processing, liquefaction and terminal facilities were assumed - one each in Yakutat, Seward, and the Kodiak Islands. There, the gas will be processed in volumes approaching 700 MMCFGPD for shipment to the Lower 48; these facilities were assumed to come on line in the three centers with 500 MMCFGPD capacity by 1983 and 750 MMCFGPD by 1987. (See Exhibit 1-10.)

With the addition of Gulf of Alaska development, population is expected to rise to 513,000 people by 1978, exceeding an 11-percent growth rate. Growth should slow in the following 2 years, with population reaching 641,000 by 1980. By 1990, we project population to climb to over 937,000.

Total employment should grow somewhat faster, moving to 260,000 by 1980 and 388,000 by 1990. Unemployment is projected to remain relatively constant from 1978 to 1980 even though employment grows by 33 percent in that time. The unemployment rate would grow closer to "normal" Alaskan levels of over 11.5 percent by 1990 as the effects of construction completions are felt. (See Exhibit 1-11.)

BEAUFORT SEA

We assumed the Beaufort Sea offshore area will be explored between now and 1990, with the peak of exploratory activity occurring in 1978 to 1982. One discovery (with associated gas) was assumed to occur between 1975 and 1977, and one each in 1978, 1981, and 1984. A

gas discovery was assumed for 1986. Development is expected to be delayed, beginning in 1979 and lasting through 1990. Oil production was assumed to begin in 1981, with production peaking in 1990 at over 800,000 BOPD. Should discoveries of this magnitude occur, we assume a new 30-inch crude pipeline will be constructed through the TAPS corridor, operable in 1984, and associated terminal facilities will be expanded at the Valdez site.

We further assumed that gas production will begin in 1981, reaching a peak of over 2 billion CFGPD by 1991. These volumes would require a second gas pipeline, parallel to the El Paso line, to be onstream by 1986, along with new liquefaction plants and terminals or expansion of existing facilities to handle about 1.5 billion CFGPD. (See Exhibit 1-12.)

Should this development take place, we project an Alaskan population of 533,000 by 1978, 711,00 by 1980, and 992,000 by 1990. The labor force participation rate is expected to increase by over 42 percent from 1978 to 1980, when total employment is forecast to be almost 300,000. By 1990, employment is expected to reach 412,000. (See Exhibit 1-13.)

BERING SEA

This scenario assumed that exploration will begin in the Bering Sea in 1976, peaking in the period 1978 to 1985, and continuing almost to the end of the century. Major oil discoveries were assumed for 1979, 1981, 1983, 1985 and 1993, with gas discoveries occurring in 1980, 1982, 1983, 1986, and 1994. Development was assumed to lag discovery by 3 years, with development drilling peaking in 1985-1989.

Oil production was assumed to start in 1984, with the peak year occurring in 1991 when production will reach 468,000 BOPD. Oil production was assumed to take place in two main areas: Norton Sound and near the Pribilof Islands. Offshore tanker loading was also assumed; consequently, no onshore processing or transportation facilities were assumed. (See Exhibit 1-14.)

Should these assumptions come about, the economic impact in the next 15 years or so should be small, relative to the previous scenarios. Population in 1978 is expected to experience an increment of only 3,000 people; however, 8,000 are expected to be added by 1980, and 33,000 by 1990. (See Exhibit 1-15.)

LOWER COOK INLET

This scenario assumed that exploration will begin in the Lower Cook Inlet by 1977, remaining relatively stable through 1984 and ending in 1989. Major oil discoveries were assumed for 1979, 1981, and 1983,

with a gas discovery assumed to occur in 1980 and in 1984. Development was assumed to lag discovery by 3 years, continuing through 1989. At peak production, in 1988, 296,000 BOPD were assumed to be produced. Pipelines to an onshore terminal somewhere on the Kenai peninsula were also assumed.

Gas was assumed to be produced beginning in 1985, rising to a peak volume of 720 MMCFGPD by 1990. We further assumed that the gas will be transported to shore for liquefaction and shipment. (See Exhibit 1-16.)

This development scenario would have relatively minor incremental impacts. Population would reach 540,000 by 1978, 727,000 by 1980, and 1.05 million by 1990. It would also result in 1,7000 new jobs by 1978, over 4,000 by 1980, and over 10,000 by 1990. (See Exhibit 1-17.)

KOTZEBUE

This scenario assumed that exploration will begin in the Kotzebue Sound area in 1975, with eight exploratory wells per year being drilled at peak exploration in 1978. Oil discoveries were assumed to occur in 1978 and 1980; however, we assumed relatively small amounts of oil will be produced from these reserves, with a peak of 117,000 BOPD in 1984. Gas discoveries were assumed for 1979 and 1982 but were assumed to be too small for commercial development.

To transport the crude, we assumed an onshore pipeline of approximately 150 miles from Kotzebue Sound to Norton Sound to seek a more ice-free port. No other onshore processing or transport facilities were assumed. (See Exhibit 1-18.)

The addition of the Kotzebue development alternative to the previously discussed scenarios could result in the state population's reaching 542,000 by 1978 (an 18-percent growth rate), 737,000 by 1980 (a 17-percent growth rate in the 1978-1980 period), and 1.06 million by 1990, (a growth rate of less than 5 percent). Employment is expected to double between 1978 and 1990, reaching 439,000. (See Exhibit 1-19.)

BRISTOL BAY

Exploration in Bristol Bay was assumed to begin in 1977, with the exploration peak occurring in 1980-1983. Oil discoveries were assumed for 1979 and 1982. Gas discoveries were assumed to occur in 1980 and 1984. After development begins in 1982, oil production was assumed to climb from an initial volume of 120,000 BOPD in 1984 to over 200,000 BOPD by 1988, the peak production year. Offshore loading was assumed. Gas, reaching 400 MMCFGPD by 1989, was assumed to be processed and liquefied onshore for shipment to the Lower 48. (See Exhibit 1-20.)

Should these assumptions prevail, the cumulative state population could reach 543,000 in 1978, 743,000 in 1980, and 1.07 million by 1990. Employment could grow to 446,000 by 1990, over 25 percent greater than the state's current population. (See Exhibit 1-21.)

NAVAL PETROLEUM RESERVE #4

This scenario assumed that exploration and development of NPR-4 will take place under contract to either the Department of the Navy or the Department of the Interior. We assumed that development will be extensive for the next 20 years, with the number of exploratory wells drilled per year peaking in the 1978-1985 period. Discoveries will occur regularly throughout the period, the first occurring in 1978. We also assumed that production of oil will begin 6 years after the first discovery, reaching a peak volume of 1.4 MMBOPD in 1990. Gas production was assumed to lag oil production by 1 year, moving from an initial production volume of 780 MMCFGPD in 1985 to a peak of 2,680 MMCFGPD 10 years later. (See Exhibit 1-22.)

Should this oil and gas be produced, we assumed both will be transported through the Alyeska utility corridor. Under this assumption, required facilities will include collection lines; a west to east median diameter pipeline running to the TAPS pipeline head; a second 42-inch line south to Valdez, carrying oil from both Beaufort Sea and NPR-4; and a second large-diameter gas pipeline. An additional 1.3-million-BOPD oil terminal located in the Valdez area and on line by 1985 will be required as well as liquefaction and gas terminals with 1 billion CFGPD by 1985, expanding to 2.3 billion CFGPD by 1987.

The impacts associated with this scale of development could be substantial. The development alternative is projected to add over 9,000 to the population by 1978, 13,000 by 1980, and almost 65,000 by 1990. This represents a compounded growth rate of over 8 percent for the next 15 years. Employment is projected to grow to 311,000 by 1980 and 473,000 by 1990. (See Exhibit 1-23.)

CHUKCHI SEA

This development scenario assumed that exploration will begin in the Chukchi Sea in 1980, and continue through the next 2 decades. Six oil discoveries and a like number of gas discoveries were assumed to occur over this period. Oil production was not assumed to occur until 1986 at which time it will be 112,000 BOPD. Gas production is expected to be delayed until 1989. Facilities required initially will be a tie-in to the NPR-4/TAPS connection. (See Exhibit 1-24.)

Adding this scenario would have a small impact, relative to the other scenarios. The incremental population increase will be less than 2,000 in 1980 but about 60,000 by 1990. (See Exhibit 1-25.)

ARCTIC WILDLIFE RANGE

This scenario assumed that exploration will take place in the Arctic Wildlife Range from 1985 to 1990. One discovery was assumed to occur in 1987. No production was assumed before 1994. (See Exhibit 1-26.)

This development alternative, when added to the others, should push total Alaskan employment to over 500,000 in 1990. No population impacts are expected before 1980, but by 1990, Alaska's population could be as high as 1.2 million.

BASE CASE (PRUDHOE)
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: None

Exploration Peak: None

Discoveries	<u>Oil</u>	<u>Gas</u>
	No New Discoveries	
Production (Oil)	<u>Year</u>	<u>Volume</u>
Initial	1977	1.2 MMBOPD
Peak	1980-1991	1.6 MMBOPD
Production (Gas)	<u>Year</u>	<u>Volume</u>
Initial	None	(See Prudhoe Bay Gas)
Peak	None	(See Prudhoe Bay Gas)

Major Facilities

Alyeska Pipeline

Valdez Terminal

BASE CASE (COOK INLET)
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: None

Exploration Peak: None

Discoveries	<u>Oil</u>	<u>Gas</u>
	None	
Production (Oil)	<u>Year</u>	<u>Volume</u>
Initial	Ongoing	
Peak	Declining Slowly	
Production (Gas)	<u>Year</u>	<u>Volume</u>
Initial	Ongoing	
Peak	Declining Slowly	
Facilities		
No New Facilities		

SCENARIO RESULTS—BASE CASE

Year: 1978	Population(000)	Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment
Previous Scenario															
Primary															
Induced															
Total	467	3,000	13,000	10,000	6,000	11,000	4,000	18,000	41,000	24,000	6,000	15,000	27,000	177,000	28,000
Year: 1980															
Previous Scenario															
Primary															
Induced															
Total	488	3,000	14,000	11,000	6,000	12,000	4,000	18,000	46,000	25,000	7,000	15,000	29,000	190,000	26,000
Year: 1990															
Previous Scenario															
Primary															
Induced															
Total	813	3,000	25,000	14,000	12,000	24,000	4,000	18,000	95,000	48,000	13,000	17,000	61,000	334,000	44,000

* Finance, Insurance, Real Estate.

OTHER PRUDHOE PRIVATE OIL
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: 1975-1984

Exploration Peak: 1976-1977

Discoveries	<u>Oil</u>	<u>Gas</u>
	1979	1979
	1981	1980
Production (Oil)	<u>Year</u>	<u>Volume</u>
Initial	1980	384,000 BOPD
Peak	1988	926,000 BOPD
Production (Gas)	<u>Year</u>	<u>Volume</u>
Initial	None (See Prudhoe Bay Gas)	
Peak	None (See Prudhoe Bay Gas)	

Major New Facilities

Expansion of Valdez terminal facilities.

SCENARIO RESULTS-PRUDHOE PRIVATE

Year: 1978		Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population(000)
Previous Scenario		3,000	13,000	10,000	6,000	11,000	4,000	18,000	41,000	24,000	6,000	15,000	27,000	177,000	28,000	467
Primary		2,000	†											2,000		
Induced			1,000		1,000	2,000			1,000	2,000	†		2,000	8,000		
Total		4,000	14,000	10,000	6,000	13,000	4,000	18,000	42,000	25,000	7,000	15,000	28,000	186,000	29,000	489
Year: 1980																
Previous Scenario		3,000	14,000	11,000	6,000	12,000	4,000	18,000	46,000	25,000	7,000	15,000	29,000	190,000	25,000	488
Primary		3,000			†									3,000		
Induced			1,000		1,000	3,000			2,000	2,000	†		2,000	11,000		
Total		6,000	15,000	11,000	7,000	15,000	4,000	18,000	48,000	28,000	7,000	15,000	31,000	204,000	27,000	519
Year: 1990																
Previous Scenario		3,000	25,000	14,000	12,000	24,000	4,000	18,000	95,000	48,000	13,000	17,000	60,000	334,000	44,000	813
Primary		3,000			†									3,000		
Induced			2,000		1,000	3,000			3,000	3,000	1,000		3,000	16,000		
Total		6,000	26,000	14,000	13,000	27,000	4,000	18,000	98,000	51,000	13,000	17,000	64,000	353,000	47,000	858

* Finance, Insurance, Real Estate.

† Less than 1,000

PRUDHOE BAY NATURAL GAS - EL PASO
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: None

Exploration Peak: None

Discoveries	<u>Oil</u>	<u>Gas</u>
	None	
Production (Oil)	<u>Year</u>	<u>Volume</u>
Initial	None	
Peak		
Production (Gas)	<u>Year</u>	<u>Volume</u>
Initial	1980	1600 MMCFGPD
Peak	1986	3300 MMCFGPD

New Major Facilities

El Paso pipeline, 42" diameter, North Slope to Gravina Point, constructed 1977-1981.

One liquefaction plant, 3 billion CFGPD initial capacity, at Gravina Point; construction during 1977-1981. Expansion by 1985.

One LNG terminal, 3 billion CFGPD initial capacity, at Gravina Point; construction during 1977-1981, expansion by 1985.

SCENARIO RESULTS-PRUDHOE BAY NATURAL GAS-EL PASO

Year: 1978		Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population(000)
Previous Scenario		4,000	14,000	10,000	6,000	13,000	4,000	18,000	42,000	25,000	7,000	15,000	28,000	186,000	29,000	489
Primary			2,000											2,000		
Induced			†		†	1,000			†	†	†		1,000	3,000		
Total		4,000	17,000	10,000	7,000	13,000	4,000	18,000	43,000	26,000	7,000	15,000	29,000	191,000	29,000	499
Year: 1980																
Previous Scenario		6,000	15,000	11,000	7,000	15,000	4,000	18,000	48,000	28,000	7,000	15,000	31,000	204,000	27,000	519
Primary		†	15,000											15,000		
Induced			3,000		1,000	4,000			4,000	5,000	1,000		7,000	26,000		
Total		6,000	33,000	11,000	8,000	19,000	4,000	18,000	52,000	33,000	8,000	15,000	39,000	245,000	30,000	
Year: 1990																
Previous Scenario		6,000	26,000	14,000	13,000	27,000	4,000	18,000	98,000	51,000	13,000	17,000	64,000	353,000	47,000	858
Primary		1,000		1,000	†	†								2,000		
Induced			1,000		1,000	1,000			2,000	2,000	1,000		2,000	9,000		
Total		7,000	27,000	15,000	14,000	29,000	4,000	18,000	99,000	53,000	14,000	17,000	66,000	364,000	48,000	883

* Finance, Insurance, Real Estate.

† Less than 1,000.

PRUDHOE BAY NATURAL GAS - ARCTIC
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: None

Exploration Peak: None

Discoveries:	<u>Oil</u>	<u>Gas</u>
	None	
Production (Oil):	<u>Year</u>	<u>Volume</u>
Initial		
Peak	None	

Production (Gas):	<u>Year</u>	<u>Volume</u>
Initial	1980	2000 MMCFGPD
Peak	1983	2250 MMCFGPD

New Major Facilities:

Pipeline, 42" diameter, North Slope through Canada to Pittsburgh, Los Angeles, and San Francisco, constructed 1977-1980.

SCENARIO RESULTS-PRUDHOE BAY NATURAL GAS-ARCTIC

Year: 1978															Population (000)
Previous Scenario	4,000	14,000	10,000	6,000	13,000	4,000	18,000	42,000	25,000	7,000	15,000	28,000	186,000	29,000	439
Primary		137		†	†			†	†	†			100		
Induced		†		†	†							†	200		
Total	4,000	14,000	10,000	7,000	13,000	4,000	18,000	42,000	25,000	7,000	15,000	28,000	186,000	29,000	490
Year: 1980															Population (000)
Previous Scenario	6,000	15,000	11,000	7,000	15,000	4,000	18,000	48,000	28,000	7,000	15,000	31,000	204,000	27,000	519
Primary	200	600											900		
Induced		†		100	300			†	300	100		300	1,100		
Total	6,000	16,000	11,000	7,000	15,000	4,000	18,000	48,000	28,000	7,000	15,000	31,000	206,000	27,000	524
Year: 1990															Population (000)
Previous Scenario	6,000	26,000	14,000	13,000	27,000	4,000	18,000	98,000	51,000	13,000	17,000	64,000	353,000	47,000	868
Primary	1,100		†	†	†								1,100		
Induced		400		400	1,100			†	1,200	300		1,200	4,700		
Total	7,000	26,000	14,000	13,000	28,000	4,000	18,000	98,000	52,000	13,000	17,000	65,000	359,000	47,000	874

* Finance, Insurance, Real Estate.

GULF OF ALASKA
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: 1975-1991

Exploration Peak: 1979-1982

Discoveries	<u>Oil</u>	<u>Gas</u>
	1977, 1979	1978, 1980
	1981, 1983	1981, 1982
	1986	1984, 1985
Production (Oil)	<u>Year</u>	<u>Volume</u>
Initial	1982	128,000 BOPD
Peak	1992	544,000 BOPD
Production (Gas)	<u>Year</u>	<u>Volume</u>
Initial	1983	322 MMCFGPD
Peak	1990	2072 MMCFGPD

New Major Facilities

Assuming an even distribution of resources in Yakutat, near Seward, and on Kodiak Island, one 500 MMCFGPD processing plant, 500 MMCFGPD liquefaction plant, and same size LNG terminal by 1983.

Increase in capacity to 750 million by 1987 at each site.

SCENARIO RESULTS—GULF OF ALASKA

Year: 1978		Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population (000)
Previous Scenario		4,000	17,000	10,000	7,000	13,000	4,000	18,000	43,000	26,000	7,000	15,000	29,000	191,000	29,000	499
Primary		1,000	†											1,000		
Induced			†		†	1,000			1,000	1,000	†		1,000	4,000		
Total		5,000	17,000	10,000	7,000	14,000	4,000	18,000	43,000	27,000	7,000	15,000	30,000	196,000	30,000	513
Year: 1980																
Previous Scenario		6,000	33,000	11,000	8,000	19,000	4,000	18,000	52,000	33,000	8,000	15,000	39,000	245,000	30,000	609
Primary		2,000	2,000											4,000		
Induced			2,000		1,000	2,000			2,000	2,000	†		2,000	11,000		
Total		7,000	36,000	11,000	9,000	21,000	4,000	18,000	54,000	35,000	9,000	15,000	41,000	260,000	32,000	641
Year: 1990																
Previous Scenario		7,000	27,000	15,000	14,000	29,000	4,000	18,000	99,000	53,000	14,000	17,000	66,000	364,000	48,000	883
Primary		3,000	†		†									4,000		
Induced			2,000		1,000	4,000			3,000	4,000	1,000		4,000	20,000		
Total		11,000	29,000	15,000	15,000	32,000	4,000	18,000	102,000	58,000	15,000	17,000	70,000	388,000	52,000	937

* Finance, Insurance, Real Estate.

† Less than 1,000.

BEAUFORT SEA
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: 1975-1990

Exploration Peak: 1978-1982

Discoveries	<u>Oil</u>	<u>Gas</u>
	1975-1977 1978, 1981 1984	1986
Production (Oil)	<u>Year</u>	<u>Volume</u>
Initial	1981	112,000 BOPD
Peak	1990	818,000 BOPD
Production (Gas)	<u>Year</u>	<u>Volume</u>
Initial	1981	252 MMCFGPD
Peak	1991	2180 MMCFGPD

New Major Facilities:

Crude pipeline, 30" diameter, parallel to TAPS line, construction in years 1981-1983.

Expanded terminal at Valdez of approximately 500 MBOPD on line by 1984.

Gas pipeline, 1979-1983 construction, parallel to El Paso line, 30" diameter.

Liquefaction plant and terminal, 1500 MMCFGPD at Gravina Point by 1984.

SCENARIO RESULTS-BEAUFORT

Year: 1978		Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population(000)
Previous Scenario		5,000	17,000	10,000	7,000	14,000	4,000	18,000	43,000	27,000	7,000	15,000	30,000	196,000	30,000	513
Primary		2,000												2,000		
Induced			1,000		1,000	2,000			1,000	1,000	†		1,000	7,000		
Total		7,000	18,000	10,000	8,000	16,000	4,000	18,000	45,000	28,000	7,000	15,000	32,000	205,000	31,000	533
Year: 1980																
Previous Scenario		7,000	36,000	11,000	9,000	21,000	4,000	18,000	54,000	35,000	9,000	15,000	41,000	260,000	32,000	641
Primary		3,000	3,000											6,000		
Induced		2,000	2,000		2,000	5,000			4,000	5,000	1,000		5,000	25,000		
Total		12,000	41,000	11,000	11,000	26,000	4,000	18,000	58,000	39,000	10,000	15,000	46,000	292,000	35,000	711
Year: 1990																
Previous Scenario		11,000	29,000	15,000	15,000	32,000	4,000	18,000	102,000	58,000	15,000	17,000	70,000	388,000	52,000	937
Primary		3,000		†	†	†								4,000		
Induced			2,000		2,000	3,000			3,000	4,000	1,000		4,000	20,000		
Total		14,000	31,000	15,000	17,000	36,000	4,000	18,000	105,000	62,000	16,000	17,000	74,000	412,000	55,000	992

* Finance, Insurance, Real Estate.

† Less than 1,000.

BERING SEA
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: 1975-1997

Exploration Peak: 1978-1985

Discoveries

Oil

Gas

1979, 1981
1983, 1985
1993

1980, 1982
1983, 1986
1994

Production (Oil)

Year

Volume

Initial

1984

128,000 BOPD

Peak

1991

468,000 BOPD

Production (Gas)

Year

Volume

Initial

1985

322 MMCFGPD

Peak

1992

1470 MMCFGPD

Facilities:

Offshore Loading Only

SCENARIO RESULTS-BERING SEA

Year: 1978	Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FINC*	Non-categorized	Services	Total Employment	Unemployment	Population(000)
Previous Scenario	7,000	18,000	10,000	8,000	16,000	4,000	18,000	45,000	28,000	7,000	15,000	32,000	205,000	31,000	533
Primary	†												†		
Induced		†		†	†			†	†	†		†	1,000		
Total	8,000	18,000	10,000	8,000	16,000	4,000	18,000	45,000	29,000	7,000	15,000	32,000	207,000	31,000	536
Year: 1980															
Previous Scenario	12,000	41,000	11,000	11,000	26,000	4,000	18,000	57,000	39,000	10,000	15,000	46,000	292,000	32,000	711
Primary	1,000												1,000		
Induced		†		†	1,000			†	1,000	†		1,000	3,000		
Total	13,000	41,000	11,000	11,000	27,000	4,000	18,000	58,000	40,000	10,000	15,000	47,000	295,000	36,000	719
Year: 1990															
Previous Scenario	14,000	31,000	15,000	17,000	36,000	4,000	18,000	106,000	62,000	16,000	17,000	74,000	412,000	55,000	992
Primary	2,000												2,000		
Induced		1,000		1,000	2,000			2,000	3,000	1,000		2,000	12,000		
Total	16,000	32,000	15,000	18,000	39,000	4,000	18,000	108,000	65,000	16,000	17,000	77,000	426,000	57,000	1,025

* Finance, Insurance, Real Estate.

† Less than 1,000.

LOWER COOK INLET
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: 1977-1989

Exploration Peak: 1978-1984

Discoveries	<u>Oil</u>	<u>Gas</u>
	1979	1980
	1981	1984
	1983	
Production (Oil)	<u>Year</u>	<u>Volume</u>
Initial	1984	96,000 BOPD
Peak	1988	296,000 BOPD
Production (Gas)	<u>Year</u>	<u>Volume</u>
Initial	1985	320 MMCFGPD
Peak	1990	720 MMCFGPD

New Major Facilities:

Onshore oil terminal, 300 MBPD, at Kenai Peninsula by 1984

Gas processing, liquefaction, and LNG terminal, 750 MMCFGPD by 1985 at Kenai.

SCENARIO RESULTS--LOWER COOK INLET

Year: 1978		Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population(000)
Previous Scenario		8,000	18,000	10,000	8,000	16,000	4,000	18,000	45,000	29,000	7,000	15,000	32,000	207,000	31,000	536
Primary		†												†		
Induced			†		†	†			†	†		†	1,000			
Total		8,000	18,000	10,000	8,000	17,000	4,000	18,000	45,000	29,000	7,000	15,000	32,000	209,000	31,000	540
Year: 1980																
Previous Scenario		13,000	41,000	11,000	11,000	27,000	4,000	18,000	58,000	40,000	10,000	15,000	47,000	295,000	36,000	719
Primary		1,000	†											1,000		
Induced			†		†	1,000			†	1,000	†		1,000	3,000		
Total		14,000	42,000	11,000	11,000	28,000	4,000	18,000	59,000	41,000	10,000	15,000	48,000	299,000	36,000	727
Year: 1990																
Previous Scenario		16,000	32,000	15,000	18,000	39,000	4,000	18,000	108,000	65,000	16,000	17,000	77,000	426,000	57,000	1,025
Primary		1,000		†										1,000		
Induced			1,000		1,000	1,000			2,000	2,000	†		2,000	9,000		
Total		18,000	33,000	16,000	18,000	40,000	4,000	18,000	109,000	67,000	17,000	17,000	79,000	437,000	58,000	1,049

* Finance, Insurance, Real Estate.

† Less than 1,000.

KOTZEBUE
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: 1975-1983

Exploration Peak: 1978-1980

Discoveries	<u>Oil</u>	<u>Gas</u>
	1978	1979
	1980	1982
Production (Oil)	<u>Year</u>	<u>Volume</u>
Initial	1982	45,000 BOPD
Peak	1984	117,000 BOPD
Production (Gas)	<u>Year</u>	<u>Volume</u>
Initial		None
Peak		

Major New Facilities:

Small pipeline to Norton Sound from Kotzebue Sound

Oil terminal of 125,000 BOPD by 1982.

SCENARIO RESULTS-KOTZEBUE SOUND

Year: 1978		Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population(000)
Previous Scenario		8,000	18,000	10,000	8,000	17,000	4,000	18,000	45,000	29,000	7,000	15,000	32,000	209,000	32,000	536
Primary		†	†		†	†			†	†	†			†		
Induced																
Total		8,000	18,000	10,000	8,000	17,000	4,000	18,000	45,000	29,000	7,000	15,000	32,000	210,000	31,000	542
Year: 1980																
Previous Scenario		14,000	42,000	11,000	11,000	28,000	4,000	18,000	58,000	41,000	10,000	15,000	48,000	299,000	36,000	727
Primary		†	1,000											1,000		
Induced			†		†	1,000			1,000	1,000	†		1,000	3,000		
Total		14,000	43,000	11,000	12,000	28,000	4,000	18,000	59,000	41,000	10,000	15,000	48,000	303,000	36,000	737
Year: 1990																
Previous Scenario		18,000	33,000	16,000	18,000	40,000	4,000	18,000	109,000	67,000	17,000	17,000	79,000	437,000	58,000	1,049
Primary		†												†		
Induced			†		†	†			†	†	†		†	2,000		
Total		18,000	33,000	16,000	19,000	41,000	4,000	18,000	110,000	67,000	17,000	17,000	79,000	439,000	59,000	1,055

* Finance, Insurance, Real Estate.

† Less than 1,000.

BRISTOL BAY
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: 1977-1991

Exploration Peak: 1980-1983

Discoveries	<u>Oil</u>	<u>Gas</u>
	1979 1982	1980 1984
Production (Oil)	<u>Year</u>	<u>Volume</u>
	Initial 1984	120,000 BOPD
Peak	1988	212,000 BOPD
Production (Gas)	<u>Year</u>	<u>Volume</u>
	Initial 1985	198 MMCFGPD
Peak	1989	400 MMCFGPD

Facilities:

Offshore crude loading

Processing, liquefaction, and LNG terminal 400 MMCFGPD by 1985.

SCENARIO RESULTS-BRISTOL BAY

Year: 1978		Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population (000)
Previous Scenario		8,000	18,000	10,000	8,000	17,000	4,000	18,000	45,000	29,000	7,000	15,000	32,000	210,000	31,000	542
Primary		†												†		
Induced			†		†	†			†	†	†		†	†		
Total		8,000	18,000	10,000	8,000	17,000	4,000	18,000	45,000	29,000	7,000	15,000	32,000	211,000	31,000	543
Year: 1980																
Previous Scenario		14,000	43,000	11,000	12,000	28,000	4,000	18,000	59,000	41,000	10,000	15,000	48,000	303,000	36,000	737
Primary		†												†		
Induced			†		†	†			†	†	†		†	2,000		
Total		15,000	43,000	11,000	12,000	29,000	4,000	18,000	59,000	42,000	10,000	15,000	49,000	306,000	37,000	743
Year: 1990																
Previous Scenario		18,000	33,000	16,000	19,000	41,000	4,000	18,000	110,000	67,000	17,000	17,000	79,000	439,000	59,000	1,055
Primary		1,000		†	†									1,000		
Induced			1,000		†	1,000		1,000	1,000	1,000	†		1,000	5,000		
Total		19,000	34,000	16,000	19,000	42,000	4,000	18,000	111,000	68,000	17,000	17,000	80,000	446,000	60,000	1,069

* Finance, Insurance, Real Estate.

† Less than 1,000.

NAVAL PETROLEUM RESERVE #4
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: 1975-1997

Exploration Peak: 1978-1985

Discoveries:	<u>Oil</u>	<u>Gas</u>
	1978, 1980	1978*, 1980*
	1983, 1991	1983*, 1991
	1993, 1995	1993, 1995

Production (Oil)	<u>Year</u>	<u>Volume</u>
Initial	1984	456,000 BOPD
Peak	1990	1.4 MMBOPD

Production (Gas)	<u>Year</u>	<u>Volume</u>
Initial	1985	780 MMCFGPD
Peak	1995	2680 MMCFGPD

Facilities:

Major 42" pipeline** along Alyeska route, new gas pipeline along Alyeska route, 1.3 million BPD oil terminal at Valdez by 1984. Liquefaction and LNG terminal facilities for one billion CFGPD by 1985 and 2.7 billion by 1995.

* Associated only

** Replaces Beaufort Pipeline

SCENARIO RESULTS--NPR-4

Exhibit 1-23

Year: 1978	Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population (000)
Previous Scenario	8,000	18,000	10,000	8,000	17,000	4,000	18,000	45,000	29,000	7,000	15,000	32,000	211,000	31,000	543
Primary	†												1,000		
Induced		†		†	1,000			†	1,000	†		1,000	3,000		
Total	9,000	18,000	10,000	8,000	18,000	4,000	18,000	45,000	30,000	8,000	15,000	33,000	215,000	32,000	552
Year: 1980															
Previous Scenario	15,000	43,000	11,000	12,000	29,000	4,000	18,000	59,000	42,000	10,000	15,000	49,000	306,000	37,000	743
Primary	1,000												1,000		
Induced		†		†	1,000			1,000	1,000	†		1,000	5,000		
Total	16,000	43,000	11,000	12,000	30,000	4,000	18,000	60,000	43,000	11,000	15,000	50,000	311,000	38,000	756
Year: 1990															
Previous Scenario	19,000	34,000	16,000	19,000	42,000	4,000	18,000	111,000	68,000	17,000	17,000	80,000	446,000	60,000	1,069
Primary	4,000		†	†	1,000								5,000		
Induced		2,000		2,000	4,000			4,000	5,000	1,000		5,000	23,000		
Total	23,000	36,000	16,000	21,000	46,000	4,000	18,000	115,000	73,000	18,000	17,000	85,000	473,000	64,000	1,133

* Finance, Insurance, Real Estate.

† Less than 1,000.

CHUKCHI SEA
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: 1980-1999

Exploration Peak: 1988-1992

Discoveries:	<u>Oil</u>	<u>Gas</u>
	1982, 1985	1983, 1984
	1987, 1989	1986, 1988
	1990, 1994	1992, 1995
Production (Oil)	<u>Year</u>	<u>Volume</u>
Initial	1986	112,000 BOPD
Peak	1995	1.5 MMBOPD

Facilities:

Tie in to NPR-4/TAPS connector

SCENARIO RESULTS-CHUKCHI

Year: 1978		Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population(000)
Previous Scenario		9,000	18,000	10,000	8,000	18,000	4,000	18,000	45,000	30,000	8,000	15,000	33,000	215,000	32,000	552
Primary																
Induced																
Total		9,000	18,000	10,000	8,000	18,000	4,000	18,000	45,000	30,000	8,000	15,000	33,000	215,000	32,000	552
Year: 1980																
Previous Scenario		16,000	43,000	11,000	12,000	30,000	4,000	18,000	60,000	43,000	11,000	15,000	50,000	311,000	38,000	756
Primary		†													†	
Induced			†		†	†			†	†	†		†		1,000	
Total		16,000	43,000	11,000	12,000	30,000	4,000	18,000	60,000	43,000	11,000	15,000	50,000	313,000	38,000	758
Year: 1990																
Previous Scenario		23,000	36,000	16,000	21,000	46,000	4,000	18,000	115,000	73,000	18,000	17,000	85,000	473,000	64,000	113
Primary		4,000												4,000		
Induced			2,000		2,000	4,000			3,000	4,000	1,000		4,000	21,000		
Total		27,000	38,000	16,000	22,000	51,000	4,000	18,000	118,000	78,000	19,000	17,000	90,000	499,000	68,000	1,192

* Finance, Insurance, Real Estate.

† Less than 1,000.

ARCTIC WILDLIFE RANGE
DEVELOPMENT ASSUMPTIONS SUMMARY

Exploration Period: 1985-1990

Exploration Peak: 1987-1989

Discoveries	<u>Oil</u>	<u>Gas</u>
	1987	
Production (Oil)	<u>Year</u>	<u>Volume</u>
Initial	1994	450,000 BOPD
Peak	1995	600,000 BOPD
Production (Gas)	<u>Year</u>	<u>Volume</u>
Initial	1994	750 MMCFGPD
Peak	1995	2000 MMCFGPD

Facilities:

None before 1990.

SCENARIO RESULTS-ARCTIC WILDLIFE RANGE

Exhibit 1-27

Year: 1978		Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population(000)
Year: 1978	Previous Scenario	9,000	18,000	10,000	8,000	18,000	4,000	18,000	45,000	30,000	8,000	15,000	33,000	215,000	32,000	552
	Primary															
	Induced															
Total		9,000	18,000	10,000	8,000	18,000	4,000	18,000	45,000	30,000	8,000	15,000	33,000	215,000	32,000	552
Year: 1980		Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population(000)
Year: 1980	Previous Scenario	16,000	43,000	11,000	12,000	30,000	4,000	18,000	60,000	43,000	11,000	15,000	50,000	313,000	38,000	758
	Primary															
	Induced															
Total		16,000	43,000	11,000	12,000	30,000	4,000	18,000	60,000	43,000	11,000	15,000	50,000	313,000	38,000	758
Year: 1990		Mining	Construction	Manufacturing	Wholesale	Transportation	Utilities & Communication	Federal	State & Local	Retail Trade	FIRE*	Non-categorized	Services	Total Employment	Unemployment	Population(000)
Year: 1990	Previous Scenario	27,000	38,000	16,000	22,000	51,000	4,000	18,000	118,000	78,000	19,000	17,000	90,000	499,000	68,000	1,192
	Primary	1,000												1,000		
	Induced		†		†	1,000			1,000	1,000	†		1,000	4,000		
Total		28,000	38,000	16,000	23,000	52,000	4,000	18,000	119,000	78,000	19,000	17,000	90,000	503,000	68,000	1,202

* Finance, Insurance, Real Estate.

† Less than 1,000.

Anchorage Average Annual Employment (1972) cont.

<u>Sector</u>	<u>Employment</u>
<u>Other</u>	
Government	
Federal	9,435
State and Local	7,839
Noncategorized	<u>76</u>
Total	48,252 =====

Anchorage, frequently referred to as "the air crossroads of the world," is the most important trade center for all of western Alaska and the transshipment point to interior and northern points for materials arriving by air, truck, sea, and railroad. The headquarters of the Alaskan Railroad is in Anchorage, and two highways radiate from the city to those points that are currently accessible by road. Anchorage has four major airfields, and is served by over 30 trucking firms and numerous barge and van companies. A major expansion and modernization program was recently completed at Anchorage International Airport, and another international terminal building will be completed in the next few years. Port facilities include a city-owned and operated general cargo dock and a petroleum dock to accommodate tankers. In addition, Anchorage is served by railroad from Whittier and Seward.

The police department employs 77 patrolmen, and there are 20-35 state troopers in Anchorage. The fire department has 78 personnel, including 67 firemen, and maintains several operating vehicles, including a petroleum-fire-extinguishing truck (January 1974).

The city's public schools are attended by 41,771 students; private and vocational schools are also located in the area. Anchorage residents obtain their health care services through six hospitals with a total of 1,074 beds, 10 clinics, and various other medical facilities. An additional 125-bed facility is scheduled for completion in 1976.

Development Potential

Within the city limits, 425 acres are available for industrial use. Most of the light industrial and potential warehousing sites are located in the Alaska Railroad Reserve. Some industrial land is also available around the major airfields and along the Alaska Railroad right-of-way. Outside the city, 2,125 acres are available for industrial siting. Approximately 75 percent of the land in the

Greater Anchorage Area Borough cannot be developed, however, because of the rough, mountainous terrain.

Environmental Quality

Data on ambient air quality for varying locations in Anchorage (center city-commercial, suburban-residential, center city-residential, and remote) provided by the National Aerometric Data Bank indicate that particulate levels recorded at certain stations exceed the maximum allowable level specified in the Alaska Air Pollution Control Regulations. Data were also available from the National Emissions Data System on current emissions from several source categories. No detailed data exist for SO_x , NO_x , HC, or CO.

All major streams that flow through the Anchorage metropolitan area (Ship, Campbell, Rabbit, and Little Rabbit) still have salmon runs except Chester Creek, which was at one time affected by pollution but is now of cleaner quality. An analysis of the water quality data summary provided on Anchorage, Elmendorf Air Force Base, and Fort Richardson by the Environmental Protection Agency (EPA), Region X, Data Systems Branch, indicates that the average parameter measurements are less than maximum allowable levels for all surface water systems, except the color measurements that were taken at several monitoring locations on Chester and Campbell Creeks.

The City of Anchorage is located in the Coastal Trough Province, composed chiefly of a series of lowlands broken by oval groups of mountains. The vegetation of the Coastal Trough is complex, varying according to a wide range of site characteristics. Anchorage is immediately surrounded by a lowland spruce-hardwood forest ecosystem. This ecosystem is a dense-to-open interior lowland forest of evergreen and deciduous trees, including extensive pure stands of black spruce. The slow-growing stunted tamarack is generally associated with black spruce in the wet lowlands. Neither species is of significant commercial value because of its light weight and small diameter. Undergrowth species include cottongrass, ferns, lichens, and a thick cover of sphagnum and other mosses.

The forests of the Coastal Trough provide permanent habitat to a variety of animals, including such big game species as black bear, and fur bearers of commercial importance such as mink, marten, and wolverine. Open tree stands with lichens provide excellent winter range for caribou. The lowland spruce-hardwood forest system also serves as an important sheltering and browsing area for moose.

The marshes and wetlands adjacent to Anchorage provide nesting and rest areas to thousands of migratory birds as well as to the endangered peregrine falcon and swans.

Economic Impacts

The projected population and employment impacts in the Anchorage election district as a result of our oil and gas development scenarios are significant. Under base-case conditions, population will increase to 225,000 by 1978, 240,000 by 1980, and 350,000 (or more than double today's population) by 1990. (See Exhibit 2-1.)

The impact of future development, however, could change the projected population and employment picture significantly. Because Anchorage is the economic hub of the state, each project should have an economic impact on the area. The largest impacts, however, are expected to come collectively from North Slope development (including other Prudhoe oil, North Slope gas, and the Beaufort Sea oil and gas). If the Beaufort Sea scenario were realized, 32,000 people could be added to the base-case by 1980. The employment mix, however, should not change significantly. Should all of the development alternatives be carried out (Arctic scenario), Anchorage's election district population could grow to 453,000 by 1990. This represents a growth rate of almost 7.5 percent. Impact of growth at this rate can be minimized by recognizing in advance the strain that this growth could put on the infrastructure.

Environmental Impacts

The only conclusion that can be drawn about air quality impacts is that particulate levels should continue to be above air quality standards. Total particulate emissions could double by 1990. Other significant impacts that could come about as a result of growth are a doubling (by 1990) of all other emissions except carbon monoxide, which could triple. (See Exhibit 2-2.)

Because little heavy manufacturing growth is forecast (that is, no direct oil and gas activity is forecast), water quality effects from this source would be minimal. The major load on the water ecosystem in the area should be a substantial increase in municipal sewage load.

As Exhibit 2-3 shows, the land required for development could exceed existing land in the Anchorage Borough (108,000 acres) if the traditional split of development between the city proper and the election district were maintained. Leap frog development may occur, with adverse impacts occurring on the surrounding forests and lowlands.

BARROW

The Barrow Election District (population 2,633 in 1970) is located on the ice-packed Arctic Ocean at the northernmost point of the United States. The largest community in the election district, Barrow, is

also the largest native community on the North Slope. By far the largest land area in the district is NPR-4, set aside as a potential oil and gas development area for the Department of the Navy.

Barrow is inhabited primarily by two Eskimo groups, the Taiiamuit and the Nuunamuit. Total population of the community in November 1974 was 2,307. Recently, the Taiiamuit have supplemented their subsistence lifestyle by providing skilled and unskilled labor to construction projects, thereby making the sociocultural system in the region a mixture of cash economy and subsistence. Providing labor to areas outside Barrow has also caused Barrow to experience seasonal fluctuations in its population.

The major supporters of Barrow's economy are defense installations and their contractors, the U.S. Navy's Arctic Research Laboratory, the government center of the Weather Bureau Service, the headquarters of the Arctic Slope Regional Corporation, and private companies involved in petroleum and natural gas exploration. Estimated election district employment is shown below.

Table 2

Barrow Average Annual Employment (1972)

<u>Sector</u>	<u>Employment</u>
<u>Industrial</u>	
Mining	350
Manufacturing	0
Construction	160
<u>Services</u>	
Services	237
Trade	*
Finance, Insurance, Real Estate	*
Transportation, Communication, and Public Utilities	143
<u>Other</u>	
Government	
Federal	173
State and Local	160
Noncategorized	0
Total (Including categories withheld)	1,331
	=====

* Figure withheld to avoid disclosure.

Barrow has three schools and a 12-bed hospital staffed by two doctors and a dentist. Its police department consists of two state troopers, three patrolmen, one chief of police, and a jail guard. The fire department depends on 26 volunteers.

Water is supplied to the town from a freshwater lake by two private hauling companies. Sewer facilities are available only to the hospital, the U.S. Weather Bureau, the Bureau of Indian Affairs (BIA), and the Navy Arctic Research Laboratory. Electricity is supplied by BIA to federal agencies and Barrow Utilities, Inc., which, in turn, supplies public consumers. Natural gas is supplied by the U.S. Navy to Barrow Utilities, Inc.

Because Barrow is ice-free only several weeks during the summer, it depends year-round on access by air. Scheduled flights run twice daily during summer and once a day in the winter. Charter services are also available.

Approximately 2 acres of land is all that remains available for development within the city limits. However, the land is flat and undrained and, as ice reaches to depths of more than 500 feet, piling is a necessity. All land beyond the city limits is contained within the NP4-4.

Environmental Quality

No data were available from the EPA's National Aerometric Data Bank on air quality in Barrow. However, current emissions information was available from EPA's National Emissions Data System.

Based on the available water quality data from two monitoring stations in the Barrow vicinity, it appears all measurement summaries, except the average color measurement at Esatkuat Creek (1972-1973), comply with state standards.

Barrow is located in the Arctic Coastal Plain Province, a flat, treeless area covered by a network of ice-wedge polygons. Fronting the village is a natural beach area of coarse dark sand about 200 feet wide. Thaw lakes are scattered throughout the area on the poorly drained permafrost-underlain soils, and standing water is abundant. The flat plain is broken by pingos which, with the lakes, are of ecological significance as they provide habitat for stands of emergent plants, wildlife, and nesting waterfowl.

Both wet and moist tundra systems are somewhat fragile because of cyclical climatic and biological oscillations. For example, the varying climatic conditions of the Arctic Slope affect the productivity and quality of tundra vegetation, which, in turn, causes the populations

of an important herbivore mammal of the region - the brown lemming - to fluctuate on a 4-year cycle. And fluctuations in the rodent population influence the survival changes of local predators (e.g., snowy owl, rough-legged hawk, and Arctic fox).

The tundra is quite important to residents of the Arctic Coastal Plain for edible herbs and roots, meats, hides and furs, some fuel, insulation, and crafting and building materials. It is important as a food source for game animals and as a nesting ground for migratory waterfowl. Certain vegetation on the Coastal Plain is found in no other ecosystems (e.g., the Alaska Boykima or Richardson's saxifrage).

Mammals of subsistence and commercial importance in the Arctic Coastal Plain include the barren ground grizzly bear, polar bear, wolverine, caribou, arctic hare, mink, weasel, and muskrat.

Several species of mammals have been threatened at one time or another in the Arctic Coastal Plain area. The wolf population, for example, was badly depleted in the recent past as a result of the imposition of a \$50 bounty, often collected by hunters who shot their prey from low-flying aircraft. The bounty was removed in 1970, however, and the wolf population has become more stable.

Millions of waterfowl migrate over Barrow during the summer to breed in the high Arctic. In 1970, it was noted that, during an 8-week period beginning in mid-July, over 840,000 birds passed over an observation post near Point Barrow. Important birds indigenous to the area include swans, sandhill cranes, and snowy owls.

Economic Impacts

In the base-case, the population of the Barrow election district is expected to grow to 4,900 people by 1990, after dipping somewhat late in the 1970s. (See Exhibit 2-4.)

Barrow has the potential to be impacted substantially by oil and gas development. Our projection indicates that activity in NPR-4 and the Chukchi Sea could radically alter the economic base and lifestyle of the region. For example, we project that, should NPR-4 be developed, election-district employment could double by 1978 (over the base-case) and almost quadruple by 1990 to over 17,000 people.*

Given the reliance of subsistence hunters on the land, it is likely that a wise policy would be to concentrate this population on as little area as possible.

*The 1990 estimates are probably impractical, however, because of the severe climate; therefore they are not considered realistic.

Environmental Impacts

Although no current air quality data exist, the air can be assumed to be pristine. The air emissions projected are not sufficient, we believe, to degrade the environment significantly. Water quality may be unaffected if care is taken in the handling of sewage and drilling wastes. Finally, land required should far exceed that available in the town of Barrow, meaning a likely spillover into Navy land. (See Exhibit 2-6.)

BETHEL

Bethel, with a city population of 2,921 in November 1974 (7,579 in the election district in 1970), is the medical and trade center of a vast area of southwestern Alaska. Its economy is supported by fisheries and by the maintenance of government facilities. The town serves as a supply center of a still important mining district. Estimated election district employment is shown below.

Table 3

Bethel Average Annual Employment (1972)

<u>Sector</u>	<u>Employment</u>
<u>Industrial</u>	
Mining	*
Manufacturing	*
Construction	*
<u>Service</u>	
Services	185
Trade	168
Finance, Insurance, Real Estate	*
Transportation, Communication, and Public Utilities	108
<u>Other</u>	
Government	
Federal	406
State and Local	341
Noncategorized	0
Total (including categories withheld)	1,333

* Figure withheld to avoid disclosure.

Except during the peak of the summer salmon fishing, nearly 450 local residents, with varying skills, are available for employment.

The town boasts one of the largest native field hospitals in Alaska. Seven doctors and five dentists staff the 42-bed hospital and clinic facility, while 75 teachers are in charge of educating the town's 1,074 pupils.

Water is supplied by the city from deep wells in the vicinity. The sewer system, however, is limited, and most areas are serviced by the "honey-bucket" system. Bethel Utility, Inc., supplies electricity locally.

In the 1960s an airport was built over the permafrost and spongy tundra to service bush planes supplying remote Yukon and Kuskokwim River villages. No truck or rail access is available. With a river channel to the sea, Bethel has downtown dock and warehouse facilities.

Three state troopers and six city policeman comprise the Bethel police department. Fire-fighting is handled by one paid fireman and 20 volunteers, with two pump trucks and three water supply vehicles.

Development Potential

Commercial and industrial land sites available for development are:

Inside City Limits:

Acreage Zoned	10.2 acres (100 percent vacant)
Bethel Heights	6.2 acres
Dull Lake Subdivision	4.2 acres

Outside City Limits:

Available acreage uncertain pending native land selection.

Environmental Quality

Although ambient air quality data were not available for the Bethel area, EPA's National Emissions Data System indicated current emission levels. A summary of recordings from one monitoring station on the Kuskokwim River indicates color measurements in excess of state water quality standards. There has been very little water quality monitoring to date.

The majority of impacts associated with the Kotzebue development scenario would occur around 1980, when an influx of construction workers could increase the election district population to over 16,000 people, almost 25 percent of whom would be industrial workers.

Bethel is situated within the Bering Shelf physiographic province, which is mostly a submerged level plain. In the Bethel area, it is a thaw-lake dotted marsh containing three ecosystems - moist tundra, wet tundra, and high brush.

The moist tundra system is composed of soils drier than those of wet tundra. These are well-drained, loamy, and underlain by coarse outwash and tills. Moist tundra ecosystems usually form a complete ground cover, varying from almost continuous and uniformly developed cottongrass tussocks, with sparse growth of other sedges and dwarf shrubs, to stands with few or no tussocks and the dominance of dwarf shrubs. Associated species include mosses, alpine azalea, low-growing willows, dwarf birch, and berries.

The soils supporting wet tundra are composed of peat layers overlying silty and sandy sediments, which are underlain by water-laid gravels, sands, and silts from outwash and marine sources, and may continue into peaty depressions in some uplands. The wet tundra system, usually found in areas with little topographical relief, contains nearly continuous meadows of cottongrass and other sedges, usually forming a mat rather than tussocks, as well as lichens, mosses, and dwarf shrub species. A few woody and herbaceous plants occur on the drier sites above the water table; rooted aquatic plants occur along shorelines and in the more shallow lake waters. Decomposition of vegetative growth by soil organisms is inhibited by cool soils, resulting in accumulations of sphagnum and sedge peats. This system produces significant amounts of forage for reindeer and caribou, and provides abundant rich habitat for waterfowl.

The high brush ecosystem of flood plain thickets (dense-to-open, deciduous brush systems) developed quickly on newly exposed alluvial deposits that are periodically flooded. The dominant shrubs are willows and alders. Associated shrubs are dogwood, prickly rose, and berry. This system, adaptable to variable soils, occupies low wet soils on sandy, gravelly terrace deposits with intermittent permafrost, extending to poorly drained, very gravelly and stony soils over shallow permafrost on foot slopes.

The 5-million-acre area proposed as the Yukon Delta National Wildlife Refuge to the north of Bethel supports an annual fall migration of 3 million ducks. The shores of Bristol and Kuskokwim Bays receive four migrations of birds annually, including the majority of the world's population of certain species, particularly geese and eiders, and provide nesting habitats for 170 bird species. Cape Newenham National Wildlife Refuge, between Bristol Bay and the Kuskokwim Delta, contains one of the largest nesting colonies of sea birds in North America.

A considerable commercial enterprise is based on the pelt of the northern fur seal. The main breeding ground of the northern fur seal is the Pribilof Islands in the Bering Sea, southwest of Bethel. Once near the point of extinction, the fur seal now has a healthy population. Other fauna of commercial importance to onshore areas of Bristol Bay and the Bering Sea is the red (sockeye) salmon as well as the pink, king, dog, and chum salmon.

Walrus are also found on the shores of the Bering Sea. In the recent past, this sea animal, too, has been on the verge of extinction in many areas, and its population is, even now, running close to the margin. Although the Alaskan walrus population is estimated as high as 95,000, the walrus has a slow reproduction rate, a cow bearing only one pup every 2 years. Bowhead, grey, and beluga (or white) whales, all of which are considered endangered, are also found in the Bering Sea.

Economic Impacts

Under the base line case, population is expected to grow slowly to 9,700 people in 1978, 10,000 people in 1980 and 17,000 in 1990. (See Exhibit 2-7.) Assuming that Bethel would serve as one of the staging areas for Bering Sea development, these numbers could change to 11,000 by 1978, over 12,000 by 1980, and over 25,000 by 1990. The employment base should dramatically alter in style, moving from less than 4 percent average annual industrial employment in 1990 to over 18 percent. The election district growth rate could exceed 8 percent.

Environmental Impacts

As Exhibit 2-8 shows, air emissions for all pollutants could more than double from the base-case by 1990. Developed land requirements (assuming a continuation of present development patterns) could increase developed land from approximately 2,500 acres currently to 15,000 acres by 1990. (See Exhibit 2-9.) Since the city as a whole contains less than 30,000 acres, it is likely that, should development be confined to the city limits, some ecological systems could be damaged.

CORDOVA

The City of Cordova is inhabited by 1,587 persons (July 1973 data), while the election district (Cordova-McCarthy) has a population of 1,857 (as of 1970). The area's economy is supported primarily by fishing and its related industries. Sockeye salmon and razor clam fisheries at the eastern end of Prince William Sound are of economic importance to Cordova. Government services also contribute signifi-

cantly to the work force of the Cordova area. The annual employment estimates, displayed below, indicate the importance of the government sector to the election district's economy.

Table 4

Cordova Average Annual Employment (1972)

<u>Sector</u>	<u>Employment</u>
<u>Industrial</u>	
Mining	*
Manufacturing	*
Construction	*
<u>Services</u>	
Services	128
Trade	63
Finance, Insurance, Real Estate	*
Transportation, Communication, and Public Utilities	71
<u>Other</u>	
Government	
Federal	47
State and Local	495
Noncategorized	*
Total	804
	===

* Figure withheld to avoid disclosure

Cordova's water comes from Meals Lake and Murcheson Falls in the Hewey Range and is supplied by Cordova Public Utilities, which also supplies the town with electricity. Its health care is provided by a 22-bed, municipally-owned hospital and a medical clinic staffed by one doctor and a dentist. The Cordova School District is equipped to educate students through the high school level.

Although inaccessible by road or rail, Cordova is served daily by a commercial airline; several charter services provide additional transportation. Cordova has a 7,500-foot, paved runway (state owned). The city dock can berth vessels drawing up to 18 feet, and the new Cordova municipal dock is equipped to service vessels with a 30-foot draft.

Development Potential

Although land use data are unavailable for Cordova, there are, within the Cordova city limits, 25 acres of land zoned for industrial and commercial use, including a 15-acre industrial park. Of these 25 acres, approximately 18 are vacant. Lots vary in size from 6,000 square feet to 13,000 square feet, and average 50 cents per square foot. There is no slope to this land, which is located on the water-front and within an urban renewal project reclaimed during harbor dredging. Utilities would be available to most parcels immediately. A 3-acre staging area has been provided adjacent to the Cordova municipal dock.

Beyond the city limits there is no land that has been zoned for industrial or commercial use.

Environmental Quality

There are no data available on air quality in the Cordova area from the EPA's National Aerometric Data Bank. However, that agency's National Emissions Data System has some indications of air pollution emissions. CO emissions were considerably greater than the other air pollutants in the election district during 1972-1973.

Water quality data available for the Cordova environs indicate that pollutant levels of water resources in the area are below state standards. Only a single parameter measurement, the average color level, recorded at the Stillwater monitoring station, exceeds the standard specified by state law. Water quality remains acceptable despite the fact no sewage treatment facility has been constructed to handle municipal and industrial (fish processing plant) waste.

Cordova lies within the Prince William Sound Drainage, the hydrology of which is dominated by high flows, lasting from spring breakup to winter freezeup. Tanner crab fishing in Sheep Bay on the Sound is of commercial importance to Cordova residents. Streams in the region are typically short, with very steep gradients, braided channels, and wide flood plains; most are glacier-fed, having high sediment loads.

Cordova is located within the Pacific Border Ranges Province, composed of several mountain ranges and an intermittent coastal shelf. The Cordova area belongs to the coastal western hemlock-Sitka spruce forest ecosystem. A combination of steep rocky slopes, broad mountain drainages, glacial masses, and extensive outwash and moraines form a complex of land surfaces and soils free of permafrost. Soils near timberline are shallow, coarse, loamy, and well-drained. Soils on the lower slopes and high moraines are stony, gravelly, and well-drained,

and produce one of the highest per acre yields of timber in the state. Small areas of sandy to silty soils on coastal terraces and dunes support thin stands of Sitka spruce. Undergrowth throughout the system includes blueberry, huckleberry, juniper, skunk cabbage, and fern plants. The presence of Sitka black-tailed deer in the region is important to Cordova residents, who rely on the animals for meat supplies. To the east is the Copper River delta area, an unusually productive wildlife habitat.

Abundant bird life is found in the Prince William Sound area because of the Sound's strategic location on major migration routes for species breeding farther north and the adjacent Copper River delta. Almost the entire North American population of the small, dusky Canada goose nests in the Cooper River delta. Although this subspecies is not the Aleutian Canada goose listed as rare and endangered in Threatened Wildlife of the U.S. (1973), the species is not numerous and may be threatened, should suitable habitat disappear. The delta is also one of many breeding spots for the trumpeter swan, at one time considered rare and endangered. Although now known to be fairly abundant in Alaska, the nesting success of this bird requires relatively undisturbed habitat.

Economic Impacts

Under the base-case scenario, population increases slowly from 2,000 in 1978 to 2,100 in 1980; 1990 population figures are estimated at 3,500, however. (See Exhibit 2-10.)

Because of the construction of a pipeline to carry North Slope natural gas and the location of a liquefied natural gas (LNG) facility and terminal in the Cordova vicinity, employment levels rise significantly, peaking in the early 1980s and decreasing so that 1990 figures are smaller than those of 1978, the second year of gas pipeline construction. Should additional activity be created by transportation requirements from Beaufort Sea development, total 1980 employment is projected to reach 18,200 and total population is estimated at 39,500.

Environmental Impacts

Should Cordova expand to become a staging area for gas transportation facilities, the air emissions would increase significantly. (See Exhibit 2-11.) The liquefaction process particularly contributes to additional nitrogen oxide emissions.

Because current data on land use are not available for the Cordova area, increased land requirements for the residential-commercial and other sectors cannot be projected. We have, however, land requirements for the LNG terminal. (See Exhibit 2-12.)

FAIRBANKS

Fairbanks is the main commercial center for the interior region of the state, north of the Alaskan range. In fact, the size of the city's population (24,238 in July 1974) is misleading and not indicative of Fairbanks' financial and commercial importance. The town is characterized by a central business district of modern office and apartment buildings, various transport facilities, shopping centers, and modern educational and health facilities.

Like Anchorage, much of Fairbanks' growth and prosperity can be attributed to the installation of defense bases - i.e., Fort Wainwright (Army) and Eielson Field (Air Force). In addition, a number of construction contractors maintain offices in the city, making it the center of interior and Arctic construction. And the University of Alaska contributes to the city's economy.

Currently, Fairbanks, a main staging ground for the Alyeska pipeline, is experiencing the largest boom period ever experienced in Alaska. Population has swelled as construction workers and unemployed "boomers" fill the city. There has been a change in the quality of life for many of the pre-boom residents.

Employment for the Fairbanks area is shown below.

Table 5

Fairbanks Average Annual Employment (1972)

<u>Sector</u>	<u>Employment</u>
<u>Industrial</u>	
Mining	97
Manufacturing	246
Construction	1,166
<u>Service</u>	
Services	2,387
Trade	2,560
Finance, Insurance, Real Estate	560
Transportation, Communication and Public Utilities	1,469
<u>Other</u>	
Government	
Federal	2,887
State and Local	4,199
Noncategorized	12
Total	15,503
	=====

The Municipal Utilities System supplies processed groundwater to consumers. A primary wastewater treatment plant has been built for the Fairbanks area, and work is proceeding on a multimillion-dollar area-wide secondary treatment facility to serve the military and college areas as well as the city. Within Fairbanks, the Municipal Utilities System supplies electricity; outside the city limits, it is supplied by Golden Valley Electric Association.

The population of the Fairbanks Election District was 45,864 in 1970. There are 11,155 students attending the district's 14 schools, while 2,928 are enrolled in the University of Alaska, located in a suburb of Fairbanks. Health facilities and staff consist of a 116-bed hospital, 5 clinics, 40 doctors, and 20 dentists.

The city is the northern terminus of the Alaska Railroad and the Richardson Highway, the southwestern terminus of the Steese Highway, and a focal point for both international and small bush aircraft. The airport handles thousands of tons of material being flown to the North Slope. In addition, a number of truck and bus lines serve the city.

The Fairbanks police department is composed of 60 persons, 12 patrol cars, and one mobile crime laboratory. The fire department has 70 employees and numerous facilities.

Development Potential

Originally, 7,640 acres, both within and beyond the city limits of Fairbanks, were zoned for industrial use. (See the table below.) Of this amount, 40 percent (530 acres) inside the city limits and 70 percent outside remains available. About 72,000 acres in the metropolitan area are available for development.

Table 6

Fairbanks Acreage Under Zoning

<u>Location</u>	<u>Zoning Classification</u>	<u>Acreage</u>
<u>Inside City Limit:</u>		
Southwest Fairbanks	Light industrial	580
South Fairbanks	Light industrial	40
North Fairbanks	Light industrial	210
	Heavy industrial	130
<u>Outside City Limits:</u>		
North Pole	Heavy industrial	440
Van Horn	Heavy industrial	1,760
Airport		4,480
Total		7,640
		=====

Environmental Quality

Ambient air quality data for Fairbanks were available from EPA's National Aerometric Data Bank. Samplings from monitoring stations of several categories in the area (center city-commercial, suburban-residential, rural-commercial, and rural-unqualified) indicate particulate and carbon monoxide levels in excess of state standards in certain locations. Sulphur oxide and nitrogen oxide concentrations appear to be considerably below those levels specified by state law.

During severe periods of cold in Fairbanks, large amounts of water vapor, emitted by motor vehicles, space heating systems, power-generating stations and industries, remain near ground level because of extremely high gradient temperature inversions. The resulting ice-fog in turn hinders vehicular and air traffic, and poses a hazard to human health. The Alaska Air Pollution Control Regulations specify that the Department of Environmental Conservation may "require any person proposing to build or operate an industrial process, fuel burning equipment or incinerator in areas of potential ice-fog to obtain a permit to operate and to reduce water emissions."

Water quality data for the Fairbanks area show excessive levels of turbidity, which may be due to glacial discharge, and of color, which may result from dissolved organic matter leached from bogs and tundra adjacent to streams.

The City of Fairbanks is located on the Tanana River at the boundary of the Northern Plateaus and Western Alaska physiographic provinces. It is surrounded by a bottomland spruce-poplar forest ecosystem and by a low brush, muskeg-bog ecosystem. The former is a tall, relatively dense, interior forest system of primarily white spruce mixed with cottonwood or balsam poplar. In general, the commercial stands of white spruce are on level, to nearly level, floodplains and low river terraces. Dense undergrowth consists of high and low shrubs interspersed with ferns, fireweed, lichens, herbs, and moss. Portions of the floodplains are barren during periods of low water. Soils supporting this vegetation are of three types: (1) well-drained, shallow, gravelly soils over bedrock; (2) well-drained silt loams of shallow depth over bedrock; and (3) windblown silts on lower slopes and high terraces.

The low brush, muskeg-bog ecosystem contains extensive bogs in which excessive wetness prevents tree growth. Bog vegetation consists of varying amounts of sedges, sphagnum, other mosses, and berries. Saturated flats have large patches of cottongrass tussocks. Soils supporting this ecosystem are poorly drained, deep, sandy, or silty loams with overlaying peat layers of varied thickness. Permafrost is continuous under interior Alaska muskegs. The more underlying strata are composed of stratified sands, silts, and gravels.

Both ecosystems are important to inhabitants for production of plants, mammals, and birds used for subsistence. The bottomland spruce-poplar forest system, particularly in the bushy areas, provides good habitat for fur bearers, woodland game birds and mammals, and moose.

At least 161 species of birds, including valuable game birds, have been reported in the Western Alaska province. Migrating waterfowl are found in abundance along the Tanana, Chena, Chatanika, and Salcha River. Trumpeter swans, a formerly endangered species, and still quite rare, have been reported (1968) in the Fairbanks area. Nests belonging to the peregrine falcon, an endangered species, were reported along the Tanana River in 1970.

Commercial, subsistence, and sport fisheries are very important recreationally and economically in the Fairbanks area. The Tanana River and its tributaries, flowing to the south of Fairbanks, contain many fish of commercial importance (e.g., salmon, whitefish).

Economic Impacts

The base line population projections for the Fairbanks Election District are 77,000 in 1978, 79,000 in 1980, and 125,000 by 1990. (See Exhibit 2-13.) Like Anchorage, however, the probable impacts of further North Slope development on Fairbanks could be substantial. Development through the Beaufort Sea scenario could increase Fairbanks population over the base line by 20 percent (to 92,600) by 1978, by 86 percent (to 147,000) by 1980, and 45 percent (to 182,000) by 1990. In fact, further development, including NPR-4, Chukchi, and the Arctic Wildlife alternatives could combine to make Fairbanks a city of well over 200,000 people by 1990. This represents an annual growth rate of 8-1/2 percent for the 1978-1990 period.

Environmental Impacts

Should this magnitude of development occur, indications are that particulate and carbon monoxide levels could continue to be a problem as emissions of all forms could double. (See Exhibit 2-14.) Ice and fog could also become more intense.

Although no significant growth in heavy industry should result, water quality could be affected by an increased municipal sewage load. The capacity of the new plant needs to be evaluated critically as oil and gas development progresses.

Should the present land use patterns and distribution continue, developed land in Fairbanks could be significantly increased from the present 18,000 acres to 43,000-61,000 by 1990. (See Exhibit 2-15.) At the high end of the range, much of the remaining 72,000 acres of developable land could come into use.

KOTZEBUE (KOBUK ELECTION DISTRICT)

Kotzebue, with a within-the-city population of 1,696 (January 1974), is the central city of a vast area of northwest Alaska that includes the villages of Ambler, Buckland, Deering, Kiana, Kivalina, Kobuk, Noatak, Noorvik, Point Hope, Selawik, and Shungnak (1970 population: 4,434). Tourism, trading, fishing, and hunting are the primary businesses supporting the town. Local residents hunt, fish, and gather berries for subsistence. Indeed, at least half the region's livelihood is gained from nonmonetary, subsistence income. As a result, caribou, reindeer, and moose are most important to the inland villages.

During July and August, commercial fishing goes into full swing, most of the catch being chum salmon and, later in the season, trout. Most of the fish is sold to the locally owned Kotzebue Sound Area Fisheries, but a commercial fishery, selling to Japanese buyers through the Kotzebue Sound Area Fisheries Co-op, provides substantial but seasonal employment for native people. There is little other manufacturing or natural resource development in the region. However, the surrounding area contains potentially rich jade, lead, silver, and copper deposits, which remain virtually unexplored and unexploited.

In 1972, the region's (Kobuk Labor Market Area) labor force was estimated at 1,270 persons, of which almost 23 percent was unemployed - and this was the lowest employment rate since such records were started in 1962. Indeed, the average unemployment over the past 10 years has been over 29 percent per year. As of 1972, total election district unemployment was estimated at 875 as shown on the following page.

Kotzebue has one Public Health Service hospital with 3 doctors, 7 nurses, 2 pharmacists, 3 dentists, and 50 beds. This hospital is used by all the outlying villages, which are scattered over an area of approximately 43,000 square miles. A state Public Health Service clinic also serves the area. Kotzebue Day School is run by the Bureau of Indian Affairs for approximately 510 elementary and approximately 157 high school students. The staff includes 39 teachers and 25 teachers' aides. The police department consists of a chief of police, five patrolmen, and one state trooper. The fire department has one fire chief to supervise volunteers.

The water supply for Kotzebue is piped from a lake 1-1/2 miles east of the city. Approximately 150 houses are supplied with water, and over 50 are hooked up to sewer facilities. Solid waste is disposed of in an open-pit dump.

Although Kotzebue has only 11 miles of gravel roads and no rail service, it is a regional center for air transportation. Wien Air Alaska provides daily jet service from Anchorage, with stops at Fairbanks or Nome.

Table 7Kotzebue Average Annual Employment (1972)

<u>Sector</u>	<u>Employment</u>
<u>Industrial</u>	
Mining	*
Manufacturing	*
Construction	*
<u>Service</u>	
Services	59
Trade	86
Finance, Insurance, Real Estate	*
Transportation, Communication, and Public Utilities	139
<u>Other</u>	
Government	
Federal	296
State and Local	247
Noncategorized	0
Total	875
	===

* Figure withheld to avoid disclosure.

Kotzebue Sound is free of ice 3 months out of the year. During this time, deep-draft, ocean-going vessels carry fuel, building material, heavy equipment, and food supplies to Kotzebue. However, gravel and sand deposits from the Noatak River, which enter the sound 4 miles above Kotzebue, force these vessels to anchor about 15 miles offshore.

Development Potential

There are no potential industrial sites as such in Kotzebue as there is no zoning in the city. About 2,500 acres are currently developed.

Environmental Quality

No ambient air quality data for Kotzebue were available through EPA's National Aerometric Data Bank.

Water quality data are available for Vortac Lake and June Creek in the Kotzebue area. Color recording averages are higher than those levels allowed by state law, probably because of natural causes. However, marine water data that would indicate the effect of activity at the Kotzebue Sound Area Fisheries on water quality are difficult to obtain.

Kotzebue, like other areas (e.g., Barrow) is characterized by both wet and moist tundra ecosystems.

Important mammals in the region - 31 species are known - include polar bear, wolf, wolverine, and Arctic hare.

The Noatak River Valley, directly north across the bay from Kotzebue, has one of the most varied floras in the Arctic. The Noatak River Basin, which is the largest in America still in its natural state, is a major migration route for the Arctic caribou herd of 250,000 animals. The basin also supports Dall sheep, barren ground grizzly bear, and moose populations.

The Great and Little Kobuk Sand Dunes to the southeast across Hotham Inlet are part of two great systems of stabilized dunes. The dunes encompass 300 square miles of the Kobuk River Valley, from the Brooks Range to Kotzebue Sound. The valley is situated at the crossroads of the Asiatic-North American Flyway. Kotzebue Sound itself is one of the most important breeding areas for shorebirds on the northwest coast of Alaska. Abundant wildlife in the Kobuk-Kotzebue area includes 100 bird species.

Cape Krusenstern, 35 miles northwest of Kotzebue, is renowned for having unique records and archeological remnants of man's early presence in the Arctic. Evidence of previous cultures dating back thousands of years has been found in vertical strata separated by layers of soil. One-hundred-fourteen lateral ridges, known as the Onion Portage Archeological District, have provided scientists with a picture of every cultural phase since man first ventured to North America across the Bering land bridge to hunt whale and seal and to fish for salmon.

Economic Impacts

In the base line case, the Kobuk Election District was assumed to be unaffected by oil and gas development. Population should increase to 4,600 people by 1978, 4,800 by 1980, and 8,000 by 1990.

In the Kotzebue development scenario, where we assumed that the Kotzebue Election District will be an impact site, we project that total population could grow to 6,400 by 1978, over 7,000 by 1980, and over 11,000 by 1990, significantly above the base line. (See Exhibit 2-16.) In the worst case, the potential for a significant change in

the labor mix is apparent. "Blue collar" jobs could amount to 75 percent of the labor force by 1980, compared with 5 percent in the base case. A change in lifestyle is indicated.

Environmental Impacts

As anticipated with the rise in activity as forecast by the scenario, air emissions could also rise. Emissions of all types could be expected to increase 30 to 60 percent above the base case. (See Exhibit 2-17.)

Should the current development patterns continue, land requirements could also increase to 6,700 developed acres by 1990. (See Exhibit 2-18.)

NOME

The Nome Election District includes most of the Seward Peninsula on the Bering Sea.

Nome is the largest town - 1973 city population was 2,488 (versus 5,759 for the election district) - and the economic, transportation, and government center of northwestern Alaska. The harbor has been maintained since 1936 by the U.S. Army Corps of Engineers, although no berthing facilities are available for large vessels.

The labor force, drawn from Nome and nearby rural villages, includes a large supply of skilled, semiskilled, and unskilled persons. The employment breakdown for the Nome Election District in 1972 is shown in the table on the following page.

The City of Nome supplies water to consumers from the Snake River and Moonlight Springs. Primary treatment of sewage was practiced until 1974 when the facility suffered flood damage. Electricity is supplied by Nome Light and Power Utilities.

Nome has two schools employing 51 teachers. A 24-bed hospital and a clinic are manned by three doctors and three dentists. Its police department has 7 employees, and the fire department depends on 28 volunteers to operate its two trucks.

Nome is accessible only by air, water, dogsled, and snowmobile. There are, however, three short highways from Nome to the neighboring towns of Teller, Taylor, and Council, respectively.

Table 8Nome Average Annual Employment (1972)

<u>Sector</u>	<u>Employment</u>
<u>Industrial</u>	
Mining	*
Manufacturing	*
Construction	74
<u>Service</u>	
Services	138
Trade	141
Finance, Insurance, Real Estate	*
Transportation, Communication, and Public Utilities	123
<u>Other</u>	
Government	
Federal	214
State and Local	485
Noncategorized	*
Total (including categories withheld)	1,213
	=====

* Figure withheld to avoid disclosure.

Development Potential

Within the city limits, 2,560 acres were zoned for industry, 70 percent of which is still vacant. Lots are specified at 50 feet by 130 feet. Beyond the borders of the city, 14 square miles are available to industry in lots of varying size.

Nome is constructed on permafrost, which alternately thaws and freezes as a result of the heat generated from buildings. This changing character of the soil twists the underpinnings of structures, which causes them to shift and lean. The solution to date has been to place structures on giant, sled-like runners or to sink foundations through the deep subsoil into bedrock; however, future construction would have to consider this problem very carefully.

Environmental Quality

There are no ambient air quality data for Nome available within the EPA's National Aerometric Data Bank.

Water quality data for Nome are available in the form of average, periodic recordings at selected monitoring points on water systems in the area. At certain recording stations, various parameter measurements - especially temperature, turbidity, and color - exceeded permissible levels. These high levels were most likely the result of natural causes - e.g., topsoil washed into receiving streams or the removal of forest canopies (at Moonlight Springs, the town's water supply source) and the presence of placer metals.

Nome is situated on the Seward Peninsula physiographic province, an irregular appendage of land partially separating the Chukchi and the Bering Seas. It is an expanse of broad hills and flat divides, interrupted by scattered groups of rugged mountains. Small streams flow through sharp valleys to the coastal lowlands, which contain many thaw lakes, occasional rock basins, morainal and volcanic crater lakes, and abundant ice-wedge polygons.

The moist tundra and high brush ecosystems are quite important to home-area residents since they provide edible vegetation and food sources for such game animals as black bear, brown grizzly bear, moose, Sitka black-tailed deer, Arctic and snowshoe hare, and red fox.

The proposed Chukchi-Imuruk National Reserve of some 2.7 million acres, not far from Nome, contains unusual geologic features found nowhere else in the Alaskan Arctic - e.g., lava fields and formations, waterfilled volcanoes, and granite rock towers. The reserve has numerous lakes and wetlands, providing nesting habitat to at least 250,000 ducks. Eighty-seven species of migratory birds have been spotted in the area, including two races of the endangered peregrine falcon.

Economic Impacts

The base case scenario projects election district population of 6,200, 6,400, and 10,500 for 1978, 1980, and 1990, respectively. (See Exhibit 2-19.)

Two of the scenarios are assumed to impact the Nome Election District: the Bering Sea scenario and the Kotzebue scenario. In the former, impacts associated with the development of Norton Sound could increase the population estimates to 7,600, 10,000 and 26,000 in the three years, each figure representing significant growth rates.

Environmental Impacts

Air emissions should change with the economic impacts. As Exhibit 2-20 shows, increases in air emissions could amount to 5-200 percent. Developed land under the biggest impact scenario could amount to 5-10 times the currently developed land by 1990. (See Exhibit 2-21.)

SEWARD

The Seward Election District is located on the eastern side of the Kenai Peninsula. Seward, part of the election district, is a relatively thriving community, with a 1974 population of 1,823 (in 1970, the population of the election district was 2,366). It is the southern terminus of the Alaska Railroad, the northern terminus of the Alaska Steamship Company, and the beginning of the scenic Seward Highway. The Central Alaska Ferry System connects Seward with Kodiak Island, Homer, and Cordova, and the city is served by scheduled flights, as its airport can accommodate large, propeller-driven aircraft. In 1964, a \$16 million municipal boat harbor and dock facility was built to replace the facility damaged by the earthquake.

Principal employers are the government (particularly the military), and the transportation, trade, and service industries. (See the table below.)

Table 9

Seward Average Annual Employment (1972)

<u>Sector</u>	<u>Employment</u>
<u>Industrial</u>	
Mining	*
Manufacturing	*
Construction	12
<u>Service</u>	
Services	120
Trade	126
Finance, Insurance, Real Estate	*
Transportation, Communication, and Public Utilities	*
<u>Other</u>	
Government	
Federal	43
State and Local	263
Noncategorized	*
<u>Total (including categories withheld)</u>	<u>810</u>

* Figure withheld to avoid disclosure

Seward's economy has recently been expanded by the addition of timber and fish processing industries and the University of Alaska's Institute of Marine Sciences. The local timber and sawmill company is the largest producer of timber in the state. Tourism is also a developing industry, and a resort complex was recently constructed in the Seward area.

Seward appears to have a well-developed system of basic community facilities. Its sewer and water systems have undergone rehabilitation recently, although no sewage treatment operations exist.

Two school buildings and 31 teachers serve 560 students in Seward, under the jurisdiction of the Kenai Peninsula Borough School District. Health care services consist of a modern 32-bed hospital; a 64-bed nursing home for the treatment of chronic diseases; and a medical clinic manned by two doctors, a dentist, and a Public Health Service nurse. The Seward volunteer Ambulance Corps provides immediate and fully equipped service. The town fire department is staffed by 2 full-time employees and 35 volunteer firemen, while the police department is composed of five full-time officers.

Development Potential

Seward has an advisory Planning and Zoning Commission which has designed comprehensive ordinances to enable orderly growth. Thirty-five acres within the city have been zoned for industrial use. Sixty-five percent of this zoned land is available in parcels ranging in size from small lots to four square blocks. Water and sewer lines are already on site. The terrain is gently sloping, and has excellent drainage; the subsoil is gravel. Piling would be required for piers and docks in the tidal basins.

Environmental Quality

Data on ambient air quality at a center city-commercial site indicate that the annual geometric mean of particulate observations is well below the maximum allowable level specified in the Alaska Air Pollution Control Regulations.

The summary of water quality data for various water resources in the Seward area, including Resurrection Bay, indicates that pollution levels in all comply with state standards (i.e., they do not exceed maximum permissible concentrations).

The Alpine tundra ecosystem, found on all mountain ranges of Alaska, consists of barren rocks and rubble interspersed with low herbaceous and shrubby mats. The most prominent plants in the coastal mountains are low heath shrubs. Soils supporting Alpine tundra in the

coastal mountains are composed of shallow, gravelly loams with permafrost, overlying bedrock on ridges and steep slopes; in the upper valleys and on high hills, the underlying soils are coarse till. Vegetation of this ecosystem serves as food for game animals. Regeneration is often extremely slow, with some lichens requiring over 60 years to recover after overuse or destruction.

The coastal waters off Seward and the Kenai fjords provide a suitable seasonal as well as year-round habitat for thousands of sea lions, porpoise, and 22 other species of marine mammals, including whales, dolphins, seals, and sea otters. Other wildlife in the area include moose, black and brown bear, goats, and sheep. The trumpeter swan, the rarest of North American swans (a 1968 census indicated just over 180 adults and cygnets) has a flourishing, breeding population on the Kenai Peninsula.

Economic Impacts

In the base case, the election district population is expected to move to 2,500 by 1978, 2,700 by 1980, and 4,400 by 1990. (See Exhibit 2-22.)

We have assumed that Seward would play a role in many of the scenarios. By far the largest impacts, however, would occur as a result of the Gulf of Alaska development scenario. With development between Middleton Island and Seward, assuming Seward is the staging area, we project total population to increase to almost 8,000 in 1978, 15,000 in 1980, and 23,000 in 1990. The growth rates in the next 5 years could approach 25 percent, with a substantial strain on the local infrastructure.

Environmental Impacts

Growth in air emissions is expected to match growth in population under the various scenarios. (See Exhibit 2-23.) While Seward's air quality currently exceeds Alaskan State standards, such a large growth in emissions could reverse this situation.

Should the high population projections come about, undoubtedly sewage systems and the social infrastructure elements will need to be installed.

Should the election district patterns continue, the prospect is for up to a tenfold increase in developed land requirements in the City of Seward, more in fact than is available within city limits. (See Exhibit 2-24.)

VALDEZ

The Valdez-Chitina-Whittier Election District (referred to here simply as Valdez) extends northward from Prince William Sound to the Southeast Fairbanks Election District. It had a 1970 population of 2,098. The Town of Valdez is situated at the head of mountain-ringed Valdez Bay, a 30-mile-long fjord cutting into the rugged coast of Prince William Sound to form one of Alaska's principal harbors. The area of the townsite is relatively flat compared with the surrounding topography. A steep mountain front forms the northern boundary; the mineral creek flood plain, the western; and a small tidal flat, the eastern boundary. The Worthington Glacier is a few miles out of town, as is Keystone Canyon, known for its spectacular cascading waterfalls. The proposed additions to the Chugach National Forest are close to Valdez on the west, and the existing Chugach National Forest lies to the southeast.

Valdez's population, which numbers 1,106 (July 1973) is 14 percent native, most of whom are well integrated with the cash economy of the area. In contrast, Tatitlak, a village 26 miles southwest of Valdez, has remained traditionally native because of its isolation and because its residents must supplement their income from commercial fishing with fishing and hunting for subsistence.

The principal employers in Valdez are the state government, particularly the Department of Health and Social Services and the Department of Highways. Other industries include transshipment activities and tourism. Estimated election district employment (1972) is shown in the table below. (These data were compiled prior to the impact on employment caused by the Alyeska Pipeline Service Company and its subcontractors.)

The labor force is drawn primarily from Valdez and its immediate area. Although a pool of skilled and semiskilled workers is available during most of the year, unemployment ranges from 15 percent to 25 percent, depending on the season.

Valdez's present sewer treatment facility is overloaded, but a new system, which includes a new waste water treatment facility as well as a new interceptor collector system, is under construction. Water is provided by the city from wells in the area, and electricity is supplied to users by the Copper Valley Electric Association.

Community facilities include two schools with 30 classrooms and 20 teachers, and the Harbor View Memorial Hospital with 15 beds for local use and 150 for resident patients, manned by two in-resident doctors and one visiting dentist. The police department consists of 7 officers, and 21 volunteers constitute the Valdez Fire Department.

Table 10

Valdez Average Annual Employment (1972)

<u>Sector</u>	<u>Employment</u>
<u>Industrial</u>	
Mining	*
Manufacturing	*
Construction	*
<u>Service</u>	
Services	128
Trade	63
Finance, Insurance, Real Estate	*
Transportation, Communication, and Public Utilities	71
<u>Other</u>	
Government	
Federal	47
State and Local	495
Noncategorized	*
Total (Including categories withheld)	<u>1,103</u>

* Figure withheld to avoid disclosure.

Valdez has an airport serviced by three airlines. There are three rail barge facilities but no rail link from Valdez to the interior. A 600-foot-long dock and two warehouses are located on the harbor.

Development Potential

All 23 acres zoned for industrial use within the city limits remain vacant. Some 12,000 developable acres remain.

Environmental Quality

Although data were not available on current ambient air quality levels in the city, it appears from several sources that Valdez has not experienced any significant air quality deterioration to date.

Most surface water systems in the Valdez area, according to the summary of certain parameter recordings provided by the EPA's Data Systems Branch have turbidity levels in excess of those allowed by law. This may be attributable to tailing operations in the area. At

Cascade Creek monitoring station, the average pH level was higher than state standards permit, while the average dissolved solids level at Jackson Point and the Shoup Glacier Estuary exceeded the state standards for that pollutant.

Valdez is located within the Pacific Border Range's physiographic province and within two ecosystems, the coastal western hemlock-Sitka spruce forest, and the Alpine tundra. The coastal western hemlock-Sitka spruce forest ecosystem is a combination of steep, rocky slopes; broad mountain drainages; glacial masses; and extensive outwash and moraines, forming a complex of land surfaces and soils free of permafrost. Soils near timberline are shallow, coarse, loamy, and well-drained, and produce one of the highest per acre yields of timber in the state. Small areas of sandy to silty soils on coastal terraces and dunes support thin stands of Sitka spruce. Undergrowth throughout the system includes blueberry, huckleberry, juniper, skunk cabbage, and fern plants.

The Alpine tundra system found on all mountain ranges of Alaska consists of barren rocks and rubble interspersed with low, herbaceous, and shrubby mats. The most prominent plants in the coastal mountains are low heath shrubs. Soils supporting the Alpine tundra in the coastal mountains are composed of shallow, gravelly loams with permafrost overlying bedrock on ridges and steep slopes; in the upper valleys and on high hills, the underlying soils are coarse till. Vegetation of this ecosystem is important as food for large game animals, which are hunted and trapped for subsistence by the inhabitants. But regeneration is often extremely slow; some lichens may require over 60 years to recover after overuse or destruction. Both ecosystems support black and brown grizzly bears, Dall sheep, mountain goats, and fox.

Birdlife in the Prince William Sound periphery has been characterized by one observer as one of the "greatest remaining concentrations on the face of the earth." During the first week of May of each year, for example, millions of shorebirds pass through this area. Waterfowl are also numerous in the sound, with some species present during the entire year. More than 200 species of birds, some of them quite rare and others considered endangered, have been recorded in the Valdez area.

Although nearly extinct at the turn of the century, the sea otter is now a conspicuous marine mammal in Prince William Sound; at present, the population in the sound is estimated to be about 5,000. In addition, the waters around Valdez provide the input for a valuable commercial fishery. Species recently harvested include salmon (pink, chum, and sockeye) and crabs (dungeness and king) as well as halibut, herring, and razor clams.

Economic Impacts

The base line forecast for the Valdez Election District is for a population of 3,400, 3,500, and 5,700 in 1978, 1980, and 1990, respectively. (See Exhibit 2-25.) Like Seward, we assume that Valdez could play a significant role in a number of development scenarios. We have assumed that this area will be the terminus of all North Slope oil. The results of this assumption indicate very large surges in employment and population largely as a result of construction activities in the area and northward. These large surges would not be achievable, however, since the inability of any community to accommodate this type of growth would cause employees to look elsewhere. We believe the surges here to be grossly exaggerated.

Environmental Impacts

As Exhibit 2-26 shows, the rise in air emission would not represent a significant increase above current emission levels, except perhaps under the NPR-4 scenario by 1990.

New sewage systems must be carefully evaluated in light of the boom/bust potential in the area. The risk of overbuilding must be weighed against water quality effects.

Land requirements could also increase substantially to more than 10 times current developed land, should current election district patterns continue. (See Exhibit 2-27.) The city could probably accommodate only a part of the growth.

YAKUTAT

The Skagway-Yakutat Election District is located in the northern part of the southeast Alaska panhandle. The population of the election district was 2,157 in 1970.

Yakutat is located at the eastern end of Monti Bay at the northern tip of the Tongass National Forest, approximately 210 miles northwest of Juneau. It is the largest community between the Sitka-Juneau area to the southeast and the central gulf area of Valdez-Cordova.

Monti Bay lies at the northern tip of the southeastern panhandle of Alaska, an indentation in an otherwise almost unbroken coastline. The bay has an inner fjord surrounded by abruptly rising mountains.

Mount Saint Elias, the second highest peak in the U.S. (next to Mount McKinley), is 50 miles northwest of Yakutat; the Malaspina Glacier, which faces the bay, has been visited by numerous geological expeditions because of its unusual glacial action. The proposed Wrangell-Mount Saint Elias National Park is across the bay from the Town of Yakutat. The Tongass National Forest surrounds Yakutat on the north and west.

Population in this tiny community is 330 (July 1975). With a naturally protected deepwater harbor, its primary industry is salmon fishing, and fully a third of those employed are affiliated with this work sector. (See the table below).

Table 11

Yakutat Average Annual Employment (1972)

<u>Sector</u>	<u>Employment</u>
<u>Industrial</u>	
Mining	*
Manufacturing	275
Construction	*
<u>Service</u>	
Services	77
Trade	157
Finance, Insurance, Real Estate	*
Transportation, Communication, and Public Utilities	320
<u>Other</u>	
Government	
Federal	69
State and Local	274
Noncategorized	*
Total (Including categories withheld)	<u>1,269</u>

* Figure withheld to avoid disclosure.

The labor force is made up mostly of natives drawn from within the city and its surrounding area.

The town water supply is derived from a single well; a new community sewer system began operating in October 1973. Electricity is supplied by Yakutat Power, Inc.

The town's school system provides education to 157 students through the efforts of 13 teachers. A combined medical/dental clinic is operated by two Public Health Service aides. Yakutat's police department has one part-time state trooper; the operation of its fire department depends on volunteers.

Development Potential

Land with water access can be made available for industrial development in the Town of Yakutat and in adjacent areas. There is not, however, a great deal of space for development as the habitat is surrounded by water and by the federally protected Tongass National Forest.

Environmental Quality

No data on ambient air quality or water quality for Yakutat are available.

Yakutat is situated within the Pacific Border Range's physiographic province and is surrounded by a coastal western hemlock-Sitka spruce forest ecosystem. This system is composed of a combination of steep rocky slopes, broad mountain drainages, glacial masses, and extensive outwash and moraines from a complex of land surfaces and soils free of permafrost.

Numbers of seabirds, shorebirds, and water fowl pass over Yakutat at migration time. The area provides a suitable nesting habitat for peregrine falcons (an endangered species), trumpeter swan, and bald eagles. Some of the largest Dall sheep in the world forage on the mountain slopes to the north and east of Yakutat. And a rare subspecies of the black bear, the glacier bear, pale bluish gray in color, is found near Yakutat.

Economic Impacts

The base case projections for the Yakutat Election District are for population to increase to 3,700 in 1978, 4,000 in 1989, and 6,500 in 1990. (See Exhibit 2-28.)

The Gulf of Alaska development scenario will have a major impact on Yakutat. Should this development take place, total population could go to 8,000 people by 1978, and to 23,000 by 1990 as Yakutat serves as both a staging area and the site of a processing/liquefaction plant. The implied growth rate between now and 1990 for this scenario is well over 12 percent, and is likely to cause intense infrastructural problems.

Environmental Impacts

As Exhibit 2-29 shows, air emissions are also likely to grow significantly, increasing from 25 percent to 100 percent. While it is not possible to say whether this would cause Yakutat's air quality to drop below state standards, the potential exists.

Land requirements should far exceed any available land in the Town of Yakutat; as Exhibit 2-30 shows, land requirements (assuming land was available) would increase fivefold.

ANCHORAGE EMPLOYMENT AND POPULATION RESULTS
(In Thousands)

SCENARIO	1978					1980					1990				
	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
Base Case	11.3	43.3	28.6	83.1	225.0	9.9	48.5	31.1	89.5	240.0	17.5	98.6	49.1	165.3	390.0
Outer Prince George	11.4	44.5	28.9	84.8	230.3	10.1	50.6	31.6	92.3	246.3	17.8	101.6	50.0	169.4	399.4
Prudhoe Bay Gas	11.4	44.8	28.9	85.2	231.1	10.6	54.2	32.3	97.1	256.7	17.9	102.9	50.2	171.1	403.4
Gulf of Alaska	11.4	45.5	28.9	85.8	233.3	10.8	55.5	32.5	98.9	260.4	18.1	105.3	50.6	174.1	409.7
Devilfoot Sea	11.6	46.8	29.3	87.6	239.8	11.1	59.5	33.3	104.0	271.8	18.5	108.3	51.7	179.0	420.7
Bering Sea	11.6	46.9	29.3	87.7	240.0	11.2	59.8	33.4	104.4	272.6	18.6	109.5	51.9	180.0	423.0
Lower Cook	11.6	47.2	29.3	88.1	241.9	11.2	60.6	33.5	105.3	274.7	18.8	111.6	52.3	182.7	429.4
Kotzebue Sound	11.6	47.3	29.3	88.2	242.0	11.2	60.7	33.6	105.5	275.1	18.8	111.7	52.3	182.8	429.7
Arctic Bay	11.6	47.3	29.3	88.3	242.5	11.3	61.0	33.6	105.8	276.0	18.9	112.3	52.4	183.6	431.4
ME-4	11.7	47.8	29.4	88.9	243.8	11.3	61.7	33.7	106.8	278.3	19.3	115.9	53.1	188.2	441.6
Chukchi Sea	"	"	"	"	"	"	"	"	"	"	19.7	119.3	53.8	192.7	451.5
Arctic Meltdown	"	"	"	"	"	"	"	"	"	"	19.7	119.9	54.0	193.7	453.6

Exhibit 2-1

ANCHORAGE AIR EMISSIONS
(Thousands of Tons Per Year)

1978

SUMMARY	Part.	SO _x	NO _x	HC	CO
Barrow Camp	4	5	11	19	90
Oil & Fuel Oil	5	5	11	19	137
Fuel Oil Bay Gas	5	5	18	20	138
Oil & Fuel Oil	5	5	18	20	139
Barrow	5	5	10	21	141
Barrow	5	5	12	21	141
Lower Cook Inlet	5	5	18	21	142
Kotzebue Sound	5	5	18	21	142
Bristol Bay	5	5	18	21	142
NPR-4	5	5	18	21	146
Chukchi Sea	5	5	18	21	146
Arctic Wildlife Range	5	5	18	21	146

1980

Part.	SO _x	NO _x	HC	CO
4	5	11	21	141
5	5	18	22	148
5	5	20	23	153
5	5	21	23	156
5	6	21	25	158
5	6	21	25	158
5	6	21	25	159
5	6	21	25	164
5	6	22	25	165
5	6	22	25	166
5	6	22	25	166
5	6	22	25	166

1990

Part.	SO _x	NO _x	HC	CO
7	8	11	36	235
8	9	22	36	236
8	9	34	36	237
8	10	34	36	237
9	10	36	36	253
9	10	37	37	255
9	10	37	37	255
9	10	37	37	255
9	10	37	37	255
9	10	37	38	266
9	10	37	38	267

LAND REQUIREMENTS FOR ANCHORAGE

(Acres)

<u>Scenario</u>	<u>1978</u>	<u>1980</u>	<u>1990</u>
Prudhoe Private	78,149	84,345	141,091
El Paso	78,398	88,076	142,557
Gulf of Alaska	78,998	89,423	144,806
Beaufort	78,612	96,478	145,150
Bering Sea	80,485	93,463	149,563
Lower Cook Inlet	80,818	94,197	151,835
Kotzebue	81,337	94,337	151,939
Bristol Bay	81,372	94,617	152,566
NPR #4	83,307	95,867	156,216
Chukchi Sea	83,307	95,867	159,795
Arctic Wildlife Range	83,307	95,867	160,522

BARROW EMPLOYMENT AND POPULATION RESULTS
(In Thousands)

1978

	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
Barrow	1.0	0.7	0.5	2.2	2.8
Barrow	1.0	0.8	0.5	2.3	2.8
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"
Barrow	1.0	0.8	0.5	2.3	3.0
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"
Barrow	1.9	1.9	0.8	4.6	7.4
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"

1980

	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
Barrow	0.9	0.8	0.6	2.3	2.9
Barrow	0.9	0.9	0.6	2.4	3.0
Barrow	0.9	0.9	0.6	2.4	3.1
Barrow	"	"	"	"	"
Barrow	0.9	0.9	0.6	2.4	3.2
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"
Barrow	2.2	2.8	1.1	6.0	11.5
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"

1990

	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
Barrow	1.2	1.5	1.0	3.8	4.9
Barrow	1.2	1.6	1.0	3.8	5.0
Barrow	1.2	1.6	1.0	3.8	5.1
Barrow	"	"	"	"	"
Barrow	12.	1.7	1.0	3.9	5.3
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"
Barrow	"	"	"	"	"
Barrow	6.4	8.4	2.8	17.6	37.0
Barrow	6.5	16.3	4.9	28.8	63.4
Barrow	"	"	"	"	"

Exhibit 2-4

BARROW AIR EMISSIONS
(Thousands of Tons Per Year)

1978

Part.	SO _x	NO _x	HC	CO
SCAMMIO				
Base Case	.04	.15	.15	1.60
Other Prudhoe Oil	.04	.15	.19	1.62
Prudhoe Pay Gas	"	"	"	"
Gulf of Alaska	"	"	"	"
SEALICIS				
Sea	.04	.16	.20	1.68
Earing Sea	"	"	"	"
Lower Cook Inlet	"	"	"	"
Kotenue Sound	"	"	"	"
Prudhoe Bay	"	"	"	"
WTR-4	.08	.39	.43	4.05
Chukchi Sea	"	"	"	"
Arctic Wildlife Range	"	"	"	"

1980

Part.	SO _x	NO _x	HC	CO
.04	.02	.15	.15	1.70
.05	.02	.16	.22	1.73
"	"	"	"	"
"	"	"	"	"
.05	.03	.19	.22	1.83
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
.06	.08	.59	.65	6.25
"	"	"	"	"
"	"	"	"	"

1990

Part.	SO _x	NO _x	HC	CO
.05	.05	.40	.40	2.80
.06	.05	.62	1.14	2.80
"	"	"	"	"
"	"	"	"	"
.06	.05	.62	1.14	2.80
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
.45	.46	3.26	3.22	33.3
"	"	"	"	"
"	"	"	"	"

Exhibit
2-5

LAND REQUIREMENTS FOR BARROW

(Acres)

<u>Scenario</u>	<u>1978</u>	<u>1980</u>	<u>1990</u>
Prudhoe Private	170	180	302
El Paso and Gulf of Alaska	251	183	304
Beaufort → Bristol Bay	175	192	312
NPR #4	426	648	2,071
Chukchi → Arctic Wildlife Range	426	648	3,461

1978

Exhibit 2-7

BETHEL AIR EMISSIONS
(Thousand Tons Per Year)

1978

SCENARIO
Base Case
Other Prudhoe Oil
Prudhoe Bay Gas
Guilf of Alaska
Barrow Sea
Porcupine Sea
Lower Cook Inlet
Kotzebue Sound
Bristol Bay
N2A-4
Chukchi Sea
Arctic Wildlife Refuge

Part.	SO _x	NO _x	HC	CO
.10	.07	.35	.39	3.10
.12	.07	.38	.53	4.70
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
.13	.07	.42	.63	5.33
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

1980

Part.	SO _x	NO _x	HC	CO
.10	.07	.35	.39	3.10
.17	.08	.43	.55	4.83
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
.17	.08	.47	.66	6.04
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

1990

Part.	SO _x	NO _x	HC	CO
.10	.07	.35	.39	3.50
.17	.10	.81	.88	8.09
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
.28	.17	.95	1.30	12.73
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

LAND REQUIREMENTS FOR BETHEL

(Acres)

<u>Scenario</u>	<u>1978</u>	<u>1980</u>	<u>1990</u>
Prudhoe Private → Beaufort Sea	6,163	5,666	10,591
Bering Sea, Lower Cook Inlet	6,163	7,199	15,025
Kotzebue, Bristol Bay	6,163	7,286	15,025

CORDOVA EMPLOYMENT AND POPULATION RESULTS
(In Thousands)

1978

SCENARIO	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
Base Case	0.3	0.3	0.6	1.2	2.0
Great Prudence	"	"	"	"	"
Prudhoe Bay Gas	2.4	1.3	0.2	4.0	8.2
Gulf of Alaska	"	"	"	"	"
North of Alaska	"	"	"	"	"
Barrow Sea	"	"	"	"	"
Longer Cook	"	"	"	"	"
Port of Alaska Sound	"	"	"	"	"
Barrow Bay	"	"	"	"	"
Barrow	"	"	"	"	"
Chukchi Sea	"	"	"	"	"
Arctic Wildlife	"	"	"	"	"

1980

INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
0.3	0.3	0.7	1.3	2.1
"	"	"	"	"
7.4	4.9	1.1	13.3	28.7
"	"	"	"	"
9.1	7.6	1.5	18.2	39.5
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

1990

INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
0.5	0.5	1.1	2.0	3.5
"	"	"	"	"
0.9	1.9	0.4	3.1	7.1
"	"	"	"	"
1.1	3.2	0.6	5.0	10.9
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
1.5	4.6	0.8	6.9	15.4
"	"	"	"	"
"	"	"	"	"

Exhibit 2-10

CORDOVA AIR EMISSIONS
(Thousand Tons Per Year)

	1978					1983					1987				
	Part.	SO _x	NO _x	HC	CO	Part.	SO _x	NO _x	HC	CO	Part.	SO _x	NO _x	HC	CO
1978	0.5	.6	.2	.2	1.1	.03	.04	.2	.2	1.4	.04	.05	.4	.2	1.7
1979	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1980	.1	.1	.9	.6	6.4	.2	.2	.4	2.7	15.0	.6	.6	230.5	1.5	11.4
1981	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1982	"	"	"	"	"	.4	.5	.5	3.0	20.6	.8	.8	341.3	2.8	11.9
1983	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1984	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1985	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1986	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1987	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1988	"	"	"	"	"	"	"	"	"	"	1.2	1.2	573.5	3.9	16.6
1989	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1990	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1991	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1992	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1993	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1994	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1995	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1996	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1997	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1998	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1999	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2000	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2001	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2002	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2003	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2004	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2005	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2006	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2007	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2008	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2009	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2010	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2011	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2012	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2013	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2014	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2015	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2016	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2017	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2018	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2019	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2020	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2021	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2022	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2023	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2024	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2025	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2026	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2027	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2028	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2029	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2030	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2031	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2032	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2033	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2034	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2035	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2036	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2037	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2038	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2039	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2040	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2041	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2042	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2043	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2044	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2045	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2046	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2047	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2048	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2049	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2050	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2051	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2052	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2053	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2054	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2055	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2056	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2057	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2058	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2059	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2060	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2061	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2062	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2063	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2064	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2065	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2066	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2067	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2068	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2069	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2070	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2071	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2072	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2073	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2074	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2075	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2076	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2077	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2078	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2079	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2080	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2081	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2082	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2083	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2084	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2085	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2086	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2087	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2088	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2089	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2090	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2091	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2092	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2093	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2094	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2095	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2096	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2097	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2098	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2099	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
2100	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"

LAND REQUIREMENTS FOR CORDOVA*
(Acres)

<u>Scenario</u>	<u>1978</u>	<u>1980</u>	<u>1990</u>
Prudhoe Private	--	--	--
El Paso → Gulf of Alaska	--	990	990
Beaufort → Bristol Bay	--	990	1,440
NPR #4 → Arctic Wildlife Range	--	990	4,260

* Because current land use data were not available for the area, only facility acreage requirements are included here.

FAIRBANKS EMPLOYMENT AND POPULATION RESULTS
(In Thousands)

SCENARIO	1978					1980					1990				
	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
Base Case	3.0	11.3	11.7	25.9	77.0	2.7	12.4	12.8	27.9	79.0	4.6	22.6	21.7	48.9	125.0
Other Pruthoe	3.2	13.9	12.3	29.4	84.7	3.6	17.4	14.0	34.6	93.9	5.2	30.0	23.5	58.7	147.4
North Slope Gas	3.2	13.9	12.4	29.4	84.9	6.0	24.6	16.2	46.7	126.2	5.4	32.7	24.3	62.4	153.7
Gulf of Alaska	3.2	13.9	12.4	29.5	84.9	6.0	24.6	16.3	47.0	120.7	5.4	32.7	24.7	62.8	154.6
Barrow Sea	3.4	16.4	13.1	32.9	92.5	7.2	33.2	18.4	58.9	146.8	6.2	41.4	27.1	74.7	181.4
Barrow Sea	3.4	16.4	13.1	32.9	92.6	7.2	33.3	18.5	59.0	147.0	6.2	41.5	27.2	74.9	182.0
Long Creek	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Porcupine Sound	"	"	"	"	"	7.2	33.3	18.5	59.0	147.1	"	"	"	"	"
Arctic Bay	3.4	16.4	13.1	32.9	92.6	"	"	"	"	"	6.2	41.6	27.2	75.0	182.2
Arctic-4	3.4	16.8	13.2	33.5	101.9	7.3	34.1	18.6	60.0	149.2	6.7	45.2	28.2	80.1	194.0
Chukchi Sea	"	"	"	"	"	"	"	"	"	"	7.1	48.1	28.9	84.1	203.0
Arctic Wildlife	"	"	"	"	"	"	"	"	"	"	7.1	49.9	29.3	86.2	207.9

Exhibit 2-13

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FAIRBANKS AIR EMISSIONS
(Thousands of Tons Per Year)

1978

SCENARIO	Part.	SO _x	NO _x	HC	CO
Base Case	8.9	3.5	7.6	5.6	32.3
Other Prudhoe Oil	11.2	3.5	9.0	7.3	47.9
Prudhoe Bay Gas	11.2	3.5	9.0	7.3	47.9
Gulf of Alaska	11.2	3.5	9.0	7.3	47.9
Beaufort Sea	11.4	3.6	9.6	7.7	50.
Bering Sea	"	"	"	"	"
Lower Cook Inlet	"	"	"	"	"
Kotzebue Sound	"	"	"	"	"
Bristol Bay	"	"	"	"	"
NPR-4	11.6	37.9	96.1	83.6	55.2
Chukchi Sea	"	"	"	"	"
Arctic Wildlife Range	"	"	"	"	"

1980

Part.	SO _x	NO _x	HC	CO
12.5	3.6	9.2	7	46
13.5	4.2	10.6	7.9	51.3
14.3	4.8	12.8	10.0	55.0
14.3	4.8	12.7	10.0	55.0
15.3	5.6	15.0	12.0	73.6
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
15.4	5.7	15.2	12.2	60.4
"	"	"	"	"
"	"	"	"	"

1990

Part.	SO _x	NO _x	HC	CO
16.0	9	18	7	74
18.7	5.7	16.2	7.3	78.7
18.8	6.4	16.2	10.7	73.7
18.8	6.4	16.1	10.8	78.7
19.8	7.2	18.4	12.6	81.0
20.0	7.2	19.3	14.8	97.8
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
20.4	7.5	20.3	15.7	104.1
20.7	7.8	21.0	16.4	108.8
20.9	7.9	21.5	16.8	11.4

Exhibit
2-14

LAND REQUIREMENTS FOR FAIRBANKS

<u>Scenario</u>	<u>(Acres)</u>		
	<u>1978</u>	<u>1980</u>	<u>1990</u>
Prudhoe Private	24,300	27,242	43,383
El Paso	24,356	35,194	45,389
Gulf of Alaska	24,556	35,322	45,660
Beaufort	26,652	43,202	53,712
Bering Sea	26,667	43,237	53,877
Lower Cook Inlet	26,667	43,237	53,877
Kotzebue	26,667	43,265	53,877
Bristol Bay	26,674	43,282	53,943
NPR #4	28,928	43,917	57,386
Chukchi	28,928	43,917	60,071
Arctic Wildlife Range	28,928	43,917	61,552

1990

INDUSTRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOYMENT	POPULATION
0.1	0.7	1.7	2.5	8.0
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
0.5	1.5	1.9	3.9	11.3
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

KOTZEBUE AIR EMISSIONS
(Thousands of Tons Per Year)

1978

SCENARIO	Part.	SO _x	NO _x	HC	CO
Base Case	.15	.06	.40	.37	2.60
Other Prudhoe Oil	"	"	"	"	"
Prudhoe Pay Gas	"	"	"	"	"
Gulf of Alaska	"	"	"	"	"
Beaufort Sea	"	"	"	"	"
Bering Sea	"	"	"	"	"
Lower Cook Inlet	"	"	"	"	"
Kotzebue Sound	.22	.08	.49	.51	3.74
Eristol Bay	"	"	"	"	"
NPN-4	"	"	"	"	"
Chukchi Sea	"	"	"	"	"
Arctic Wildlife Range	"	"	"	"	"

1980

Part.	SO _x	NO _x	HC	CO
.15	.05	.33	.38	2.66
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
.24	.43	.51	.54	4.06
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

1990

Part.	SO _x	NO _x	HC	CO
.23	.08	.53	.58	4.30
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
.29	.11	.75	.80	5.98
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

LAND REQUIREMENTS FOR KOTZEBUE

<u>Scenario</u>	<u>1978</u>	<u>1980</u>	<u>1990</u>
Prudhoe Private → Lower Cook Inlet	4,112	3,081	4,143
Kotzebue and Bristol Bay	4,112	5,099	6,724

NOME EMPLOYMENT AND POPULATION RESULTS
(In Thousands)

	1978					1980					1990				
	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
Scenario															
Base Case	0.2	0.6	1.3	2.1	6.2	0.2	0.6	1.4	2.2	6.4	0.3	1.0	2.3	3.6	10.5
Oil Price \$20/Bbl	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Oil Price \$15/Bbl	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Oil Price \$10/Bbl	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Oil Price \$5/Bbl	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Oil Price \$2.5/Bbl	0.4	0.9	1.3	2.7	7.6	0.6	1.5	1.6	3.7	10.0	2.0	4.5	3.8	10.4	26.0
Low Oil	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Medium Oil	0.4	1.1	1.4	3.0	8.7	1.5	2.8	1.8	6.7	16.6	2.0	4.9	3.8	10.8	27.1
High Oil	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Oil Price \$20/Bbl	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Oil Price \$15/Bbl	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Oil Price \$10/Bbl	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Oil Price \$5/Bbl	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Oil Price \$2.5/Bbl	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"

Exhibit 2-19

NOME AIR EMISSIONS
(Thousands of Tons Per Year)

1978

SCENARIO	Part.	SO _x	NO _x	HC	CO
Base Case	5.66	.07	.5	.7	4.25
Other Prudhoe Oil	5.66	.07	.5	.7	4.25
Prudhoe Bay Gas	5.66	.07	.5	.7	4.25
Gulf of Alaska	5.66	.07	.5	.7	4.25
Beaufort Sea	5.66	.07	.5	.7	4.25
Eering Sea	5.69	.09	.55	.81	5.16
Lower Cook Inlet	5.69	.09	.55	.81	5.16
Kotzebue Sound	5.70	.10	.62	.91	5.86
Bristol Bay	5.70	.10	.62	.91	5.86
NPR-4	5.70	.10	.62	.91	5.86
Chukchi Sea	5.70	.10	.62	.91	5.86
Arctic Wildlife Range	5.70	.10	.62	.91	5.86

1990

Part.	SO _x	NO _x	HC	CO
5.66	.07	.5	.7	4.4
5.66	.07	.5	.7	4.4
5.66	.07	.5	.7	4.4
5.66	.07	.5	.7	4.4
5.66	.07	.5	.7	4.4
5.72	.12	.73	1.02	6.60
5.72	.12	.73	1.02	6.60
5.80	.19	1.09	1.45	9.53
5.80	.19	1.09	1.45	9.53
5.80	.19	1.09	1.45	9.53
5.80	.19	1.09	1.45	9.53
5.80	.19	1.09	1.45	9.53

1990

Part.	SO _x	NO _x	HC	CO
5.72	.1	.71	1.07	7.0
5.72	.1	.71	1.07	7.02
5.72	.1	.71	1.07	7.02
5.72	.1	.71	1.07	7.02
5.72	.1	.71	1.07	7.02
6.20	.47	2.96	4.19	26.43
6.20	.47	2.96	4.19	28.43
6.23	.49	3.06	4.30	29.16
6.23	.49	3.06	4.30	29.16
6.23	.49	3.06	4.30	29.16
6.23	.49	3.06	4.30	29.16
6.23	.49	3.06	4.30	29.16

LAND REQUIREMENTS FOR NOME
(Acres)

<u>Scenario</u>	<u>1978</u>	<u>1980</u>	<u>1990</u>
Prudhoe Private → Beaufort	10,842	11,524	18,876
Bering Sea	13,732	17,952	52,131
Lower Cook Inlet	13,732	17,952	52,131
Kotzebue	15,636	26,491	54,211
Bristol Bay	15,636	26,491	54,211

SEWARD EMPLOYMENT AND POPULATION RESULTS
(In Thousands)

SCENARIO	Scenario 1					Scenario 2					Scenario 3					Scenario 4				
	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
Base Case	0.1	0.4	0.7	1.3	2.5	0.1	0.4	0.7	1.3	2.5	0.1	0.5	0.8	1.4	2.7	0.2	0.8	1.2	2.2	4.4
Oil Refining	0.1	0.5	0.7	1.4	2.7	0.1	0.5	0.8	1.4	2.7	0.1	0.5	0.8	1.4	2.7	0.2	0.8	1.2	2.2	4.4
100,000 Bbl Day	0.2	0.6	0.7	1.5	2.9	0.3	0.7	0.8	1.7	3.4	0.3	0.7	0.8	1.7	3.4	0.2	1.0	1.2	2.4	4.8
100,000 Bbl Day	0.7	2.0	0.8	3.5	8.0	2.2	3.6	1.4	7.2	15.2	2.2	3.6	1.4	7.2	15.2	2.2	6.4	2.4	11.0	22.9
200,000 Bbl Day	"	"	"	"	"	2.2	3.8	1.4	7.5	15.7	2.2	3.8	1.4	7.5	15.7	2.2	6.4	2.5	11.1	23.1
300,000 Bbl Day	0.7	2.4	0.8	3.9	9.0	2.3	4.7	1.5	8.5	18.1	2.3	4.7	1.5	8.5	18.1	2.4	9.0	2.8	14.2	30.4
400,000 Bbl Day	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
500,000 Bbl Day	0.7	2.4	0.8	4.0	9.0	"	"	"	"	"	"	"	"	"	"	2.4	9.1	2.8	14.3	30.6
600,000 Bbl Day	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	2.4	9.3	2.8	14.5	31.2
700,000 Bbl Day	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
800,000 Bbl Day	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"

Exhibit 2-22

SEWARD AIR EMISSIONS
(Thousands of Tons Per Year)

1978

SCENARIO	Part.	SO _x	NO _x	HC	CO
Base Case	.04	.06	.37	.17	1.16
Other Prudhoe Oil	.04	.06	.37	.17	1.16
Prudhoe Bay Gas	.04	.07	.41	.21	1.26
Gulf of Alaska	.13	.20	1.25	.61	3.50
Beaufort Sea	.13	.20	1.25	.61	3.50
Bering Sea	.13	.20	1.28	.61	3.52
Lower Cook Inlet	.15	.24	1.75	.70	3.55
Kotzebue Sound	.15	.24	1.75	.70	3.55
Pristol Bay	.15	.24	1.75	.70	3.96
NPR-4	"	"	"	"	"
Chukchi Sea	"	"	"	"	"
Arctic Wildlife Range	"	"	"	"	"

1980

Part.	SO _x	NO _x	HC	CO
.04	.06	.39	.18	1.19
.04	.06	.39	.18	1.19
.05	.06	.52	.25	1.38
.24	.38	2.36	1.14	6.62
.25	.39	2.45	1.19	6.87
.26	.39	2.45	1.19	6.94
.30	.48	2.99	1.40	7.94
.30	.48	2.99	1.40	7.94
.30	.48	2.99	1.40	7.94
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

1990

Part.	SO _x	NO _x	HC	CO
.07	.10	.64	.29	1.91
.07	.10	.64	.29	1.91
.07	.11	.66	.29	1.91
.58	.80	73.3	2.83	17.06
.59	.80	73.3	2.88	17.06
.59	.87	73.3	2.88	17.06
.70	1.05	74.32	2.88	17.06
.70	1.05	74.32	2.88	17.06
.78	1.06	74.52	2.88	17.06
.78	1.06	74.14	2.91	17.06
"	"	"	"	"
"	"	"	"	"

LAND REQUIREMENTS FOR SEWARD
(Acres)

<u>Scenario</u>	<u>1978</u>	<u>1980</u>	<u>1990</u>
Prudhoe Private	988	1,011	1,622
El Paso	1,069	1,167	1,752
Gulf of Alaska	2,787	5,385	8,264
Beaufort Sea	2,787	5,583	8,348
Bering Sea	2,811	3,884	8,611
Lower Cook Inlet	3,155	6,397	10,877
Kotzebue	3,155	6,397	10,877
Bristol Bay	3,165	6,913	10,954
NPR #4	3,165	6,913	11,146

VALDEZ EMPLOYMENT AND POPULATION RESULTS
(In Thousands)

	1978					1980					1990				
	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPUL- ATION	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPUL- ATION	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPUL- ATION
Barrow	0.2	0.5	1.2	1.8	3.4	0.2	0.5	1.3	2.0	3.5	0.3	0.9	2.1	3.3	5.7
Chukotka	0.8	1.3	1.4	3.4	7.0	0.2	0.6	1.3	2.1	3.8	0.3	1.0	2.1	3.4	6.1
Chukotka	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Chukotka	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Chukotka	"	"	"	"	"	0.3	0.8	1.4	2.5	4.6	0.4	1.1	2.2	3.6	6.4
Chukotka	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Chukotka	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Chukotka	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Chukotka	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Chukotka	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Chukotka	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Chukotka	"	"	"	"	"	"	"	"	"	"	0.5	1.7	2.3	4.4	8.2
Chukotka	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"
Chukotka	"	"	"	"	"	"	"	"	"	"	"	"	"	"	"

Exhibit 2-25

VALDEZ AIR EMISSIONS
(Thousands of Tons Per Year)

1973

SCENARIO
Base Case
Other Prudhoe Oil
Prudhoe Bay Gas
Gulf of Alaska
Baruport Sea
Loring Sea
Lower Cook Inlet
Kotzebue Sound
Bristol Bay
N2A-4
Chukchi Sea
Arctic Wildlife Range

Part.	SO _x	NO _x	HC	CO
.08	.1	.4	.3	1.3
.08	.1	.3	.6	1.8
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

1980

Part.	SO _x	NO _x	HC	CO
.05	.06	.4	.3	2.4
.05	.06	.4	.3	2.4
"	"	"	"	"
"	"	"	"	"
.06	.1	.5	.4	2.9
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

1990

Part.	SO _x	NO _x	HC	CO
.07	.09	.6	.4	2.8
.07	.09	.6	.4	2.8
"	"	"	"	"
"	"	"	"	"
.07	.09	.6	.4	2.9
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
.09	.09	.8	.5	3.7
"	"	"	"	"
"	"	"	"	"

LAND REQUIREMENTS FOR VALDEZ
(Acres)

<u>Scenario</u>	<u>1978</u>	<u>1980</u>	<u>1990</u>
Prudhoe Private	7,968	4,813	7,832
El Paso	7,968	4,813	7,832
Gulf of Alaska	7,968	4,813	7,832
Beaufort → Bristol Bay	7,968	5,776	8,216
NPR #4 → Arctic Wildlife Range	7,968	5,776	10,516

YAKUTAT EMPLOYMENT AND POPULATION RESULTS
(In Thousands)

1978

SCENARIO	INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
Base Case	0.4	1.2	0.9	2.6	3.7
Chukotka Province	"	"	"	"	"
Indigirka Bay Case	"	"	"	"	"
Gulf of Alza	0.9	2.3	1.0	4.2	7.7
Amur River	0.9	2.3	1.1	4.3	8.1
Arctic Sea	"	"	"	"	"
Lower Cook	"	"	"	"	"
Port of the Sound	"	"	"	"	"
Arctic Bay	"	"	"	"	"
1978-4	"	"	"	"	"
Chukotka Sea	"	"	"	"	"
Arctic Wildlife	"	"	"	"	"

1980

INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
0.4	1.3	1.0	2.8	4.6
0.4	1.6	1.0	3.0	4.6
0.4	1.6	1.3	3.4	5.3
2.2	3.8	1.7	7.6	14.4
2.2	3.9	2.0	8.1	15.3
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

1990

INDUS- TRIAL	TRADE AND SERVICES	OTHER	TOTAL EMPLOY- MENT	POPU- LATION
0.5	2.2	1.6	4.3	6.5
0.5	2.2	2.0	4.7	7.4
2.3	2.2	2.1	4.9	7.7
2.3	6.2	2.8	11.3	21.4
"	6.3	3.3	11.9	22.6
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
2.3	6.3	3.3	11.9	22.6
"	"	"	"	"
"	"	"	"	"

Exhibit 2-28

YAKUTAT AIR EMISSIONS
(Thousands of Tons Per Year)

1978

SCENARIO	Part.	SO _x	NO _x	HC	CO
Base Case	.04	-	.2	.2	1.3
Other Prudhoe Oil	.04	.02	.18	.16	1.28
Prudhoe Bay Gas	.04	.03	.12	.15	1.27
Gulf of Alaska	.07	.05	.24	.32	2.63
Baruport Sea	.07	.05	.25	.34	2.76
Bering Sea	"	"	"	"	"
Lower Cook Inlet	"	"	"	"	"
Kotzebue Sound	"	"	"	"	"
Bristol Bay	"	"	"	"	"
APR-4	"	"	"	"	"
Chukchi Sea	"	"	"	"	"
Arctic Wildlife Range	"	"	"	"	"

1980

Part.	SO _x	NO _x	HC	CO
.04	-	.2	.2	1.4
.05	.03	.15	.19	1.58
.05	.05	.26	.40	3.30
.12	.09	.45	.60	4.93
.13	.09	.47	.63	5.22
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

1990

Part.	SO _x	NO _x	HC	CO
.05	.1	.2	.3	2.3
.07	.04	.22	.31	2.52
.07	.04	.21	2.53	2.25
.34	.27	59.59	1.55	11.19
.34	.27	69.58	1.54	11.11
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"
"	"	"	"	"

Exhibit
2-29

LAND REQUIREMENTS FOR YAKUTAT
(Acres)

<u>Scenario</u>	<u>1978</u>	<u>1980</u>	<u>1990</u>
Prudhoe Private	108	131	209
El Paso	108	149	216
Gulf of Alaska	202	376	559
Bering Sea → Bristol Bay	203	386	582
NPR #4 → Arctic Wildlife Range	203	386	588

RESEARCH PROGRAMS IN ALASKA

This appendix enumerates the research and development programs currently being conducted in Alaska by the Environmental Protection Agency, as well as other federal, state and local agencies and private organizations. Individual projects are described within the following categories: air pollution, water pollution, ecosystems, wildlife, primary oil and gas exploration and production impacts, pipeline impacts, and socioeconomic impacts. A summary of R & D in Alaska is presented as Exhibit 8 in the main section of this report.

EPA RESEARCH PROGRAMS IN ALASKA

<u>Project</u>	<u>Air</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
Effectiveness of retrofit auto devices under cold climate conditions			EPA*	AERL
Ice fog control from cooling ponds in the sub-arctic			EPA	AERL
Effectiveness of devices to reduce ice fog emissions from autos			EPA	AERL

* Key to Exhibit 3-1:

<u>Abbreviation</u>	<u>Title</u>	<u>Abbreviation</u>	<u>Title</u>
ADF & G	Alaska Department of Fish and Game	ISEGR	Institute of Social, Economic and Government Research
AEC	Atomic Energy Commission	NARL	Naval Arctic Research Laboratory
AERL	Arctic Environmental Research Laboratory	NPS	National Science Foundation
BLX	Bureau of Land Management	NMFS	National Marine Fisheries Service
CEAEL	Cold Regions Research and Engineering Laboratory (Army)	NOMA	National Oceanic and Atmospheric Administration
EPA	Environmental Protection Agency	OCIR	Office of Naval Research
FPC	Federal Power Commission	OCRR	Office of Water Resources Research (University of Alaska)
HEA	United States Department of Health, Education and Welfare	U. of A.	University of Alaska
IAP	International Biological Program	USFS	United States Forest Service
IPS	Institute of Marine Science (University of Alaska)	USF & W Serv.	United States Fish and Wildlife Service
ISR	Institute of Water Resources (University of Alaska)	USGS	United States Geological Survey
		USB of SP & W	United States Bureau of Sport Fisheries and Wildlife

Water

<u>Project</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
Effects of stream bed disturbance on the arctic and subarctic freshwater ecosystems	To examine effects of river rechannelization on the physical, chemical, and biological features of an Alaskan subarctic river	EPA	AERL
Extended aeration sewage treatment for cold climates		EPA	indiv.
Nutrient chemistry of a large, deep lake in subarctic Alaska	To collect and compile qualitative chemical and physical data by which future variations can be evaluated; to evaluate and define the above parameters in relation to the limnological future of Harding Lake	EPA	indiv. fr. IWR

Ecosystems

<u>Project</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
Development of model of ecological systems in natural watersheds	To obtain sufficient data on all aspects of aquatic ecosystems of these subarctic watersheds to enable a watershed model to be developed to serve as a reliable tool to predict dynamic behavior of such watersheds when defined perturbations are imposed on them. The application will be to understand the function of watersheds throughout subarctic regions with similar geologic conditions.	EPA w. AERL	Various indiv.
Role of microorganisms in cold climate ecosystems	-	EPA	AERL
Baseline data study on estuarine ecosystems			

Effects of Oil

<u>Project</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
Marine sediment microbiology and effects of oil in Valdez	Prediction of effects of oil pollution	EPA W. IHP	same
Microbial oil degradation at low temperatures in the terrestrial and aquatic environments	To conduct a comprehensive literature review of microbial oil degradation with special emphasis on low temperature, fresh water and soil studies, and to develop a "state of the art" paper dealing with the low temperature, freshwater and soil aspects as appropriate. This information will aid in determining what microbial activity may be expected when oil enters arctic and subarctic freshwater and soil ecosystems, and help in added research to define role of microorganisms in oil degradation.	EPA	AERL
The sediment environment of Port Valdez and Galena Bay, Alaska and the effect of oil on the ecosystem	Baseline study of physical, chemical and biological conditions in sediment. Hydrocarbon analysis.	EPA	AERL
Effects of oil spilled in high latitude, subarctic lake systems	-	EPA	Contractor
Behavior of crude oil under ice in rivers	-	EPA	AERL
Fate and effects of crude oil on estuarine ecosystems	-	EPA	AERL

RESEARCH PROGRAMS OF OTHER ORGANIZATIONS IN ALASKA

Air

<u>Project</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
Lidar Studies of the urban atmosphere in the polar regions	Evaluate feasibility of using lidar in polar location for the study of atmospheric structure and dispersion processes within the planetary boundary layer. Aimed at rational urban development plans for polar regions.	National Science Foundation	Various indiv.
Carbon monoxide model for the City of Fairbanks	Construct and operate a computer model to simulate carbon monoxide transport in the Fairbanks basin.	Fairbanks North Star Borough	Indiv. from IWR
Ice fog dissipation techniques		CRREL*	Indiv.

* Key to Exhibit 3-2:

<u>Abbreviation</u>	<u>Title</u>	<u>Abbreviation</u>	<u>Title</u>
ADF & G	Alaska Department of Fish and Game	ISEDR	Institute of Social, Economic and Govern-
AEC	Atomic Energy Commission	MAEL	ment Research
AEDL	Arctic Environmental Research Laboratory	NPS	Hawai Arctic Research Laboratory
BLM	Bureau of Land Management	NMFS	National Science Foundation
CP-2L	Cold Regions Research and Engineering Laboratory (Army)	NOAA	National Marine Fisheries Service
EPA	Environmental Protection Agency	ONM	National Oceanic and Atmospheric Admin-
FPC	Federal Power Commission	ONR	istration
HEW	United States Department of Health, Education and Welfare	U. of A.	Office of Naval Research
Ibr	International Biological Program	USFS	Office of Water Resources Research
IES	Institute of Marine Science (University of Alaska)	USF & W Serv.	University of Alaska
INR	Institute of Water Resources (University of Alaska)	USCS	United States Forest Service
		USF & W	United States Fish and Wildlife Service
			United States Geological Survey
			United States Bureau of Sport Fisheries and Wildlife

<u>Project</u>	<u>Water</u>	<u>Description</u>	<u>Funding Agency</u>	<u>Investigator</u>
Variation in the hydrographic structure of Prince William Sound, Alaska from 1972 through September 1973		To define seasonal variations in water parameters and correlate these with weather & runoff; investigate mixing in the water, circulation using water mass analysis, & plan more detailed studies to aid in mgmt decisions & priorities for future studies having more specific goals; contributing towards a more effective fisheries research & mgmt prog there.	Univ. of A. Sea Grant Program	Indiv.
Characteristics and ultimate disposal of waste septic tank sludge		Studies conducted on waste septic tank sludge from the Fairbanks area in order to establish its qualitative characteristics & to evaluate the processes avail for ultimate disposal.	OWRR	Indiv. for IWR
Preconstruction assessment of biological water quality of Chena & Little Chena Rivers		To determine the effect of the flood control project on the biological water quality of the Chena and Little Chena Rivers.	USGS	W. Corps of Eng.
Hydrocarbons in marine waters: Port Valdez, Alaska		Baseline data and development of techniques.	Petroleum Research Foundation	Indiv. for IMS
Geohydrology of Anchorage Area		Measure the impact of man's activities on area's water resources; provide basic information necessary for economic & orderly development of additional water supplies.	USGS	Indiv.
Quality of Water Stations		Provide information on chemical and physical properties of water to establish a baseline under natural conditions from which the changes caused by man's activities can be evaluated.	USGS	Indiv.

Water
(Continued)

<u>Project</u>	<u>Description</u>	<u>Funding Agency</u>	<u>Investigator</u>
Ground-water stations	Provide information on water levels throughout Alaska indicating water in storage or transit & availability of supplies, estimate base flow of streams, long-term records for basic or watershed studies.	USGS	Indiv.
Surface water stations	Provide historic and current data on stream-flow, lake stage & contents, etc.	USGS	Indiv.
Sediment stations	Provide information on sediment in streams, lakes, estuaries.	USGS	Indiv.
Hydrologic studies			
Water resources investigation of the Kenai Peninsula Borough	Chemical and biological sampling.	USGS	Indiv.
Hydrology of the Cordova area		USGS	Indiv.
Production & decomposition of dissolved & particulate organic carbon in Arctic Coastal ponds		USGS	Indiv.
Experimental watershed	Studies provide complete information on all parameters influencing stream discharge in a given area.	MSF CRREL	Office of Polar programs Indiv.

<u>Ecosystems</u>			
<u>Project</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
Environmental studies of Cook Inlet, Alaska	Baseline data study	Collier Carbon & Chemical	Indiv. fr. IMS
Modeling vertebrate consumers in the Barrow ecosystem	To model the impact of vertebrate consumers upon the tundra ecosystem. Simulate interaction of existing hypothesis and propose new ones. Identify areas where more information is needed.	National Science Foundation	Various indiv.
Suprapermafrost water	Seeks to extend the existing knowledge of soil-water regime of permafrost soils in far N regions & involve field measurements of moisture, temp & other parameters on in-situ soils in arctic & sub-arctic Alaska.	IWR Office of Water Resources Research	Indiv.
Recovery dynamics of tundra ecosystems	To find if seral succession occurs in tundra, if reclamation promotes stability of terrestrial ecosystems, can recovery rates be predicted.	AEC	Indiv.
Coastal forest ecosystems	To determine relationships between various components of the coastal forest ecosystem & its associated environs as a base of knowledge upon which resource mgmt, protection, & enhancement can be based.	U.S. Forest Service	Same
Soil survey and investigation	Soil survey of SE Alaska developing interpretative info on soils.	U.S. Forest Service	Same
Upper Prince William Sound reconnaissance soil inventory	Reconnaissance of soil-vegetation resource inventory produced to assist forest staff in making mgmt decisions & long range planning.	U.S. Forest Service	Same

Ecosystems
(Continued)

<u>Project</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
Alaskan coastal environments	To obtain an understanding of sedimentation in high tidal range inlets.	U.S. Geological Survey	Same
Coastal study (SE Alaska)	Baseline data gathering on fish & wildlife & habitat in SE Alaska estuaries for use in eval water-oriented development (especially logging & assoc activities).	U.S. Bureau of Sport Fisheries & Wildlife	Same
Coastal survey program	Inventory fish & wildlife resources in bays & estuaries of SE Alaska; quantify & map marine littoral & benthic habitat; use information to advise developers best sites for development which will have least damaging effects on environment.	U.S. Bureau of Sport Fisheries & Wildlife	Same
Vegetation and landscape mapping, Prudhoe Bay		Tundra Biome Center	Inst. of Arctic & Alpine Research
Ecology of phytoplankton and benthic algae near Barrow, Alaska	To determine the phytoplankton & benthic algal community composition & primary production in the coastal area & the oceanographic parameters that affect these communities, eventually to provide a better understanding of the biology & oceanography of nearshore & ice edge zone marine environment.	Office of Naval Research	Indiv. from IMS
Lichens of the North Slope of Alaska	To provide a basic manual for identification of lichens of the area.	NSF w. Arctic Inst. of N. Amer.	Indiv.

Ecosystems
(Continued)

<u>Project</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
Structure of function of the tundra ecosystem at Barrow		Tundra Biome Center	Inst. of Arctic Biology
Revegetation of disturbed tundra & taiga surfaces			Indiv.
Tundra environmental changes induced by urbanization			Indiv.
Arctic & Alpine vegetation similarities, differences & susceptibility to disturbances		Tundra Biome Center	Indiv.
Vehicle perturbation effects upon a tundra soil-plant system	Effects on morphological and physical environmental properties of the soils and on the chemical regimes.		
Soil and soil organic characteristics of selected Alaskan arctic tundra environments		NSF	Office of Polar Programs
Ecosystem analysis	Designed to determine the initial response of tundra ecosystems to natural and artificial disturbances	CRREL	Indiv.

Wildlife

<u>Project</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
Fish and wildlife critical habitat areas	Define and catalog critical habitat requirements of major fish & wildlife species throughout the state.	Alaska Dept. of Fish & Game	Same
Marine mammal investigations - Northern Alaska	Life history, ecology, population status, utilization & mgmt of marine mammals of importance to Alaska residents. Application in husbandry & mgmt of marine mammals.	Alaska Dept. of Fish & Game	Same
Comprehensive wildlife management planning for Alaska		Alaska Dept. of Fish & Game	Same
Population studies of gamefish and evaluation of managed lakes in the Upper Cook Inlet drainage		Alaska Dept. of Fish & Game	Same
Shellfish investigations - Cook Inlet	Studies on crab & shrimp, population dynamics, reprod potential, effects of commercial exploitation on stocks, migration timing & patterns. Studies oriented towards stock mgmt.	Alaska Dept. of Fish & Game	Same
Inventory and cataloging of the sport fish and sport fish waters in Upper Cook Inlet	Determine & record environ characteristics of certain potential fishery waters of job area & develop & eval plans for enhancement of resident fish stocks.	Alaska Dept. of Fish & Game	Same
An assessment of the clam resources in Prince William Sound, Alaska	Resource assessment; basic biological data; econ analysis; paralytic shellfish poisoning assessment.	U. of A. Sea Grant Program	Indiv.

Wildlife
(Continued)

<u>Project</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigation</u>
Waterfowl surveys	To determine annual fluctuations in the waterfowl population so that hunting regulations can be adjusted to permit a safe kill.	U.S. Bureau of S.F. & W.	Same
Falcons on Yukon River	Determine population size and structure of peregrine falcon populations in a river system.	U.S. Bureau of S.F. & W.	Same
Investigations of wetlands and waterbirds at P. Horkerson on Alaska's arctic coastal plain	Determine importance of region to waterbirds; derive a wetland classification system that identifies important relationships between birds & wetlands; appraise trophic relationships between birds & aquatic invertebrates; assess the toxicity of oil to aquatic food resources of birds. Application - establish recommendations to reduce deleterious effects of petroleum development on the waterbird wetlands community.	U.S. Bureau of S.F. & W.	Same
North Slope spring waterbird population surveys	To learn bird populations in oilfield area of North Slope during breeding season to evaluate possible impacts & problems of construction and operation of Alyeska Pipeline on these populations. To make recommendations to minimize damages of this oil transport system.	U.S. F & W Service	Same
Upgrading data on avian status, distribution and abundance in southcentral Alaska and adjacent Gulf of Alaska	To have a baseline of data on all avian species occurring in southcentral Alaska & adjacent waters.	U.S. F & W Serv., U. of Alaska, & USFS	Indiv.

Wildlife
(Continued)

<u>Project</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigation</u>
Prince William Sound bird surveys	To learn the bird species utilizing Prince William Sound during all seasons; to estimate possible impacts & conflicts with the marine shipment of oil from the Alyeska terminal at Port Valdez. To make recommendations to reduce losses & obtain timely cleanup of possible spills.	U.S. F & W Serv., U. of Alaska, & USFS	Indiv.
Chena River-Lakes investigations	Gather baseline info on fish & wildl resources affected by the Chena River Flood Control Project.	U.S. F & W Serv., U. of Alaska, & USFS	Same
Waterfowl habitat improvement, Copper River Delta	Experimentation with waterfowl habitat improvement techniques on wetlands of Copper River Delta.	U.S. Forest Service	Same
Marine mammals of the Arctic Ocean and Bering Sea	Determine status of bowhead whale stock of Bering, Chukchi and Beaufort Seas. Collect biological data during Eskimo harvest.	Nat'l Marine Fisheries Service	Same
Avian populations of arctic Alaska: synthesis and modeling	The structure of avian populations in arctic Alaska & their function within the tundra ecosystem.	Nat'l Science Foundation	Various indiv.
Demography and nutrition of lemmings	Understanding of population dynamics & role of lemmings in tundra.	Nat'l Science Foundation	Various indiv.
Breeding ecology of the dusky Canada goose on the Copper River Delta, Alaska	To conduct intensive studies of dusky Canada goose breeding & summering on the Copper River Delta to determine prod, survival, habit use & mgmt.	Alaska Coop. Wildl. Res. Unit	Same
Activities of birds in Alaska	Distrib & status of birds of Alaska.	NSF, U. of A., & Sycamore Trust	Indiv.

<u>Project</u>	<u>Wildlife</u> (Continued)	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
Investigations of moose populations and associated habitat in interior Alaska		To study aspects of life history & ecology of moose in interior Alaska to determine basic biological parameters pertinent to effective mgmt.	A. Dept. of F & G	Same
Grayling investigations		The collection of biological information necessary for mgmt of arctic grayling in interior Alaska.	A. Dept. of F & G	Same
Dall sheep research		Determine effects on reprod, survival & range of Dall sheep by maintaining a herd below winter range carrying capacity thru either-sex harvest. Determine effects of extensive ram-only harvest. Determine general life history & ecology of Dall sheep on three study areas in Kenai Mts and monitor population changes. Application: more knowledgeable mgmt of this species.	A. Dept. of F & G	Same
Ecological adaptations of tundra invertebrates			Tundra Biome Center	Indiv.
Studies of wolf ecology in Northern Alaska		To gather info re wolf ecology & their prey in N Alaska; further knowledge of wolf ecology & understanding wolf-prey relationship.	A. Dept. of F & G	Same

<u>Project</u>	<u>Effect of Oil</u>	<u>Description</u>	<u>Funding Agency</u>	<u>Investigator</u>
Determination of acute and chronic effect of treated ballast water on selected aquatic biota from Port Valdez, Alaska	To determine acute & chronic toxicity levels of simulated treated ballast on the biota of Port Valdez; to measure the degree of hydrocarbon accumulation within tissues of selected organisms.		Alyeska	Various indiv.
Fate and effects of oil pollutants in extremely cold marine environments	To determine the consequences of oil spillages on microbial populations. Possible use of microbial degradation for its removal.		Office of Naval Research	Various indiv.
Ecological impact of oil pollution at low temperatures			Tundra Biome Center	Army Research Office
plant reaction to a heated pipeline buried in permafrost soil			Tundra Biome Center	Inst. of Arctic Biology
Response of tundra microflora to crude oil spill			Tundra Biome Center	Indiv.
The response of Alaskan terrestrial plant communities to the presence of petroleum			Tundra Biome Center	Indiv.
Oil spill response team during Valdez marine terminal construction			Alyeska	Chugach Natives Inc.

<u>Project</u>	<u>Description</u>	<u>Funding Agency</u>	<u>Investigator</u>
	<u>Pipeline Impact</u>		
Effects of pipelines and related activities on fish populations in Alaska, northwest territories, and Alberta	To assess the environ impact of pipeline constr & oper on lakes & streams within the influence of the pipeline corridor. Studies include fisheries, invertebrate & water analysis programs. Work in Ak is virtually complete & much info avail in publ reports & papers.	Canadian Arctic Gas Study, Ltd.	Various indiv.
Polar bear distribution, pipeline corridor	To assess potential impact of the construction of a buried natural gas pipeline on grizzly bears.	Canadian Arctic Gas Study, Ltd.	Various indiv.
Soil data bank	Analysis & tabulation of soils along pipeline route	Alyeska	Various indiv.
Oil spill contingency plans, Alyeska Pipeline System	Dev oil spill contingency plans for Alyeska Pipeline System.	Alyeska	Various indiv.
Barrow tundra studies	Carry ahead tundra restoration studies initiated in 1968 with the Barrow pipeline project, with special emphasis placed on tundra plots simulating a buried pipeline.	Alyeska	Various indiv.
Pipeline impact program	Valdez	Nat'l Marine Fisheries Service	Various indiv.
Aquatic ecological studies in Mackenzie-Porcupine River Watershed with special reference to gas and oil pipeline development	To assist Fed Gov in assessing appl for pipeline, highway & other pipeline related constr & operation; to assess ranges of variation of benthic organism abundances, biomasses, & productivity; to assess ranges of variation of physical & chemical parameters that influence the growth & reproduction of aquatic organisms.	Canadian Government in conjunction with private industry.	Various indiv.

<u>Pipeline Impact</u> (Continued)	<u>Project</u>	<u>Description</u>	<u>Funding Agency</u>	<u>Investigator</u>
	Ornithological investigations of the proposed Mackenzie Valley pipeline	Describe bird populations & areas of concentration along proposed pipeline route in order to (1) make recommendations to minimize impact of the pipeline on bird populations and (2) assess impact on bird populations.	Canadian Arctic Gas Study, Ltd.	Various indiv.
	Biological monitoring of benthic organisms along the Trans-Alaska Pipeline corridor	To establish baseline water quality & biol characteristics of streams & lakes along the Trans-Alaska Pipeline corridor to assess changes that may occur to the aquatic environ regarding soil erosion, chemical pollution, thermal addition & domestic pollution due to construction of the pipeline.	U.S. Geological Survey	Same
	Consulting on air pollution problems	Determination of amount of ice fog from oil pump stations along pipeline.	Esso Prod. Co.	Indiv. fr. Geophysical Inst.

<u>Project</u>	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
	<u>Socioeconomic</u>		
Man in the Arctic program: economic and environmental policies, natural resource management project	Analyze transactions among environmental biological & economical factors.	Nat'l Science Foundation	ISEGR
Man in the Arctic program: economic and environmental policies, policy alternative project	Examination of the probable economic & social dev patterns in Alaska & relationship to prospective policy objectives & actions.	Nat'l Science Foundation	ISEGR
Man in the Arctic program: economic and environmental policies of manpower project	To determine the manpower requirements & supply of job skills associated with alternative patterns of economic development.	Nat'l Science Foundation	ISEGR
Man in the Arctic program: economic and environmental policies, economics project	Analysis of the policy options & probable patterns of economic dev in Alaska.	Nat'l Science Foundation	ISEGR
Urban native adaptations in Anchorage	To develop a typology of urban native adaptations & the career lines assoc with each type of adaptation; to analyze the impact of dominant society institutions on native migrants in Anchorage.	Nat'l Science Foundation	ISEGR
Federal-State relations and Alaska's development; the Joint Federal-State Land Use Planning Commission for Alaska	Analyze structure & program of Joint F/SLUPC roles of major interest groups, & commission relations with Fed agencies & state government.	Nat's Science Foundation	ISEGR

<u>Socioeconomic</u> (Continued)	<u>Description</u>	<u>Funding Organization</u>	<u>Investigator</u>
<u>Project</u>			
Historical study of socio-economic impacts on the Kenai Peninsula and projections of socio-economic impacts in Yakutat, Dillingham, Kotzebue	Primarily anthropological	BLM, Alaska	Contractor
Bering Sea land bridge			
Socioeconomic effects of oil use gas distribution in Alaska		FPC	Resource Planning Associates